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FOR THE BUSINESS OF MICROCOMPUTING

OCTOBER 1981
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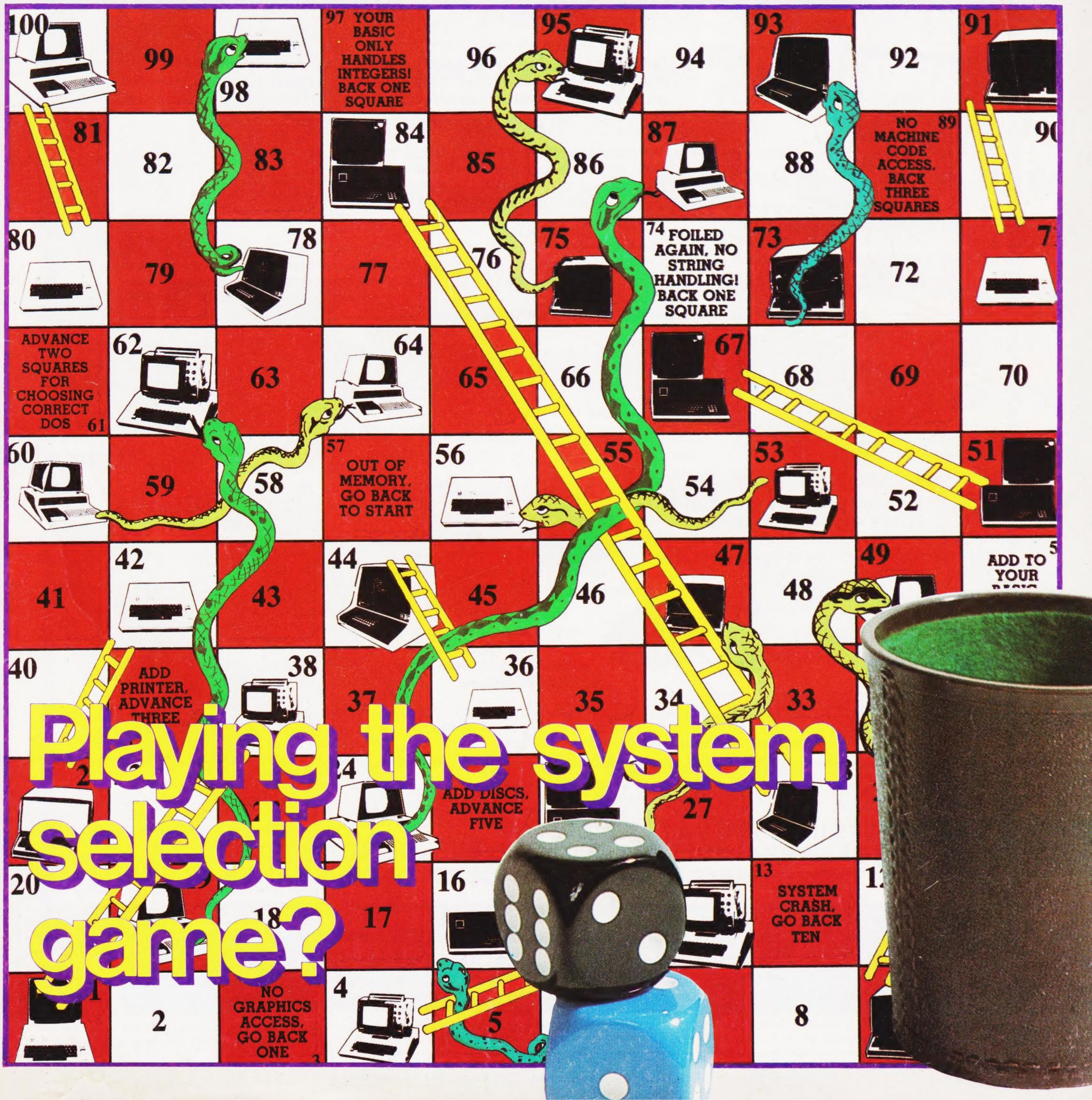

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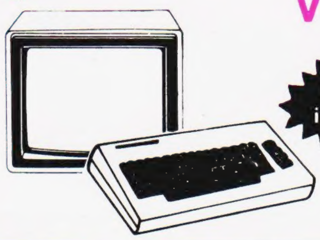
COMMODORE VIC



£189.95 incl. VAT

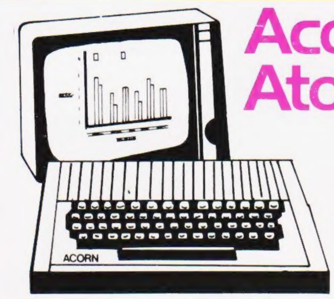
Commodore International Ltd. (AMEX-CBU) has officially introduced the world's first full-featured colour computer priced at under £200.

The new VIC 20, which retails at £189.95 was unveiled on January 8th at the Consumer Electronics Show in Las Vegas.

The new computer puts Commodore squarely in the low priced personal computer market with a fully expandable microcomputer which connects to any television set and rivals the features of existing microcomputers selling at four or five times the price. The features speak for themselves:

- colour • sound
- programmable function keys
- 5K memory expandable to 32K
- standard PETBASIC
- full-size typewriter keyboard
- graphics character set
- plug-in programme/memory cartridges
- low-priced peripherals
- joystick/paddles/lightpen
- self-teaching materials

Acorn Atom



£138.00 incl. VAT

The ATOM is a British-designed personal computer—simple to operate, and in kit form, simple to build. It has all the features found in machines twice the price or more, and yet it has one outstanding advantage. It is designed on an expandable basis.

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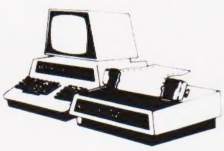

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Acting Editor : Henry Budgett
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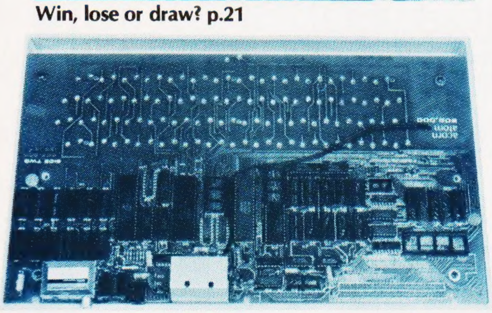
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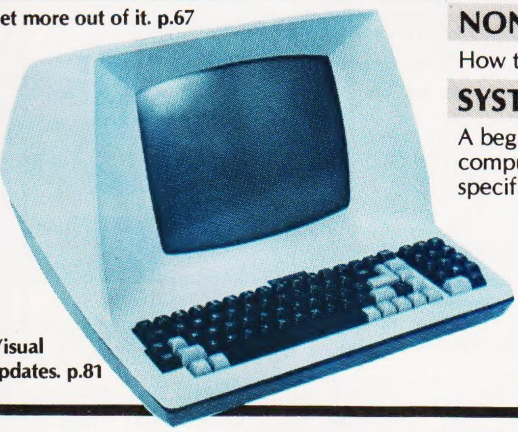
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All material should be typed, but neat hand-written copy may be considered. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

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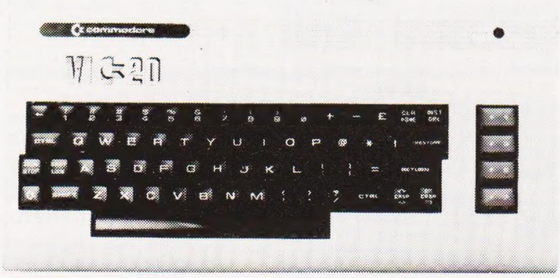
the vic centre

Adda Computers Ltd., a major supplier of computer systems to industry and business, have opened the Vic Centre in West London. Here you can see, discuss and buy everything to do with the new VIC 20 personal computer—in person or by mail. Hardware, software, technical advice and information is available from an experienced staff of experts. Even if you already own a VIC 20, get on our mailing list to know about new developments. Remember—everything has the backing of Adda's reputation, and there's a full 12-month warranty on all hardware. The Vic Centre is easy to reach— Just off the A40, close to North Acton tube station.

VIC 20



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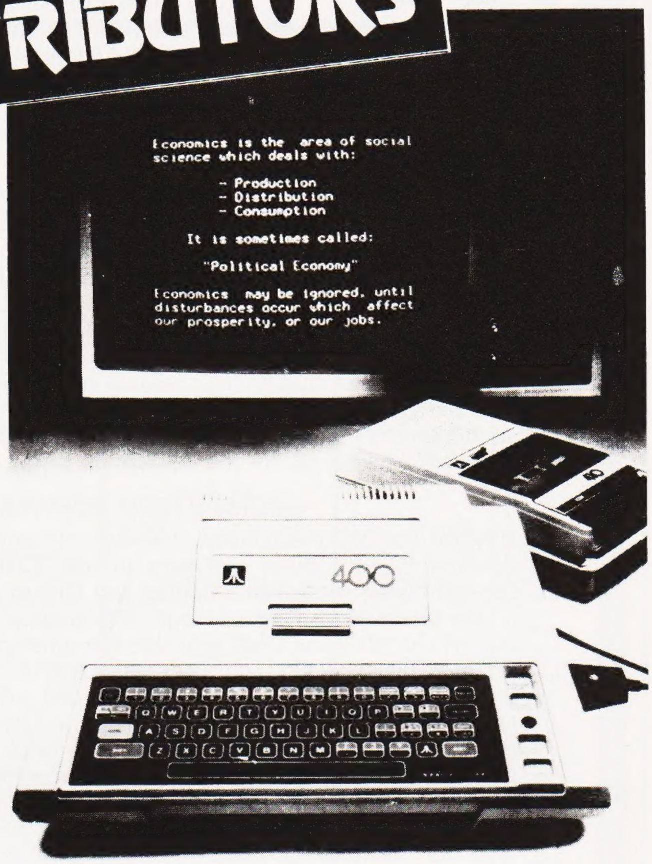

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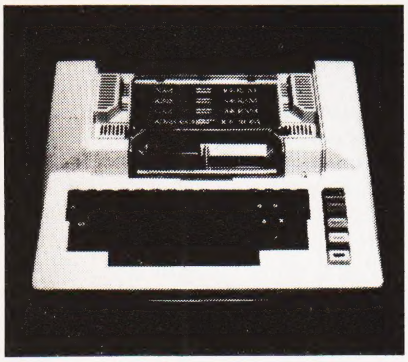

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74S112	300p
74S114	120p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
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6821	180p
6850	180p
6852	250p
6875	600p
8154	950p
8155	800p
8205	320p
8212	180p
8216	200p
8224	250p
8226	250p
8228	250p
8251	400p
8253	800p
8255	400p
8257	800p
8259	800p
8279	950p
MC14411	700p
MC14412	900p
Z80-CTC	400p
Z80A-CTC	500p
Z80-P10	400p
Z80DART	£10
Z80ADART	£12
Z80A-P10	500p
Z80-S10-1	£20

KEYBOARD ENCODER

AY-5-2376 700p

UARTS

AY-51013A	350p
AY-3-1015D	400p
IM6402	450p

MEMORIES RAMS

2101-4L	400p
2102-2L	120p
2107B	400p
2111-4L	300p
2112A	300p
2114-2L	200p
2114-4L	175p
4027-3	350p
4044-4	600p
4118-4	550p
5101	300p
6116	£12
6810	200p
6514-45	400p
4164-20	£14

ROMS

74S188	275p
74LS189	275p
74S201	450p
74S287	350p
74S387	350p
74S471	650p
74S472	900p
74S571	900p
74S573	900p
2532	£7
2732	£7

ZX80/81 USER PORT

(As described in Oct. P.W.)

ADD SOUND TO YOUR ZX80/81

Port module plugs directly into ZX80/81 to provide 8 input and 8 output lines.
These allow input of data from switches, photocells, joysticks etc. and control of upto 8 relays. Also 7 segment display or LEDs may be used, variable tone audio output may be produced – CREATE YOUR OWN SOUND EFFECTS.
This port is accessed by simple peek and poke commands.
Complete PORT KIT (incl. dble sided PCB) **£11.50**

ZX81 MEMORY DOUBLER

Double the on board RAM of ZX81 to 2K. Only one internal connection required to be made.
Price inclusive of full instructions **£13.00**

★ UK101 & SUPERBOARD II ★ INTERFACE SYSTEM

Three board interface system plugs directly into computer expansion socket to provide wide facilities accessible from BASIC or MACHINE CODE.

1. **Decoding Module** Providing a dual 5v supply, 16 bit programmable input/output port, plus extensive address decoding for a wide variety of interfaces, including full decoding for a programmable sound generator, and also a 40 pin skt for further expansion **£27.50**
2. **Analogue Board** Plugs into the Decoding module to provide D/A converter, 8 channel multiplexed A/D converter with 20 nS conversion time. AY-3-8910 Sound Generator plus 6522 VIA provide timing and counting functions & additional 16 bit port. **£39.95**
3. **Display Board** Plugs directly into the Decoding module to provide a 2 digit 0.5" LED display. A pair of such boards can give 4 digit readout. **£8.95**
4. **Memory Expansion PCB** A low price compact memory expansion board 8K RAM (2114) + 4 skts for 2716, 2732, 2532 EPROMs. Plated thru holes. Fully buffered and decoded layout. Interfacing instructions supplied. **£8.95**

INTERFACE ICs

AD561J	1400p
AD7524	600p
DAC1408-8	200p
DM8131	375p
DP8304	450p
DS8835	250p
DS8836	150p
DS8838	225p
MC1488	65p
MC1489	65p
MC3446	325p
MC3480	850p
MC3487	300p
MM58174	£12
75107	160p
75110	200p
75112	150p
75114	150p
75115	150p
75154	150p
75182	230p
75324	375p
75361	150p
75365	150p
75451/2	72p
75491/2	70p
8T26	120p
8T28	140p
8T95	140p
8T97	140p
81LS95	120p
81LS96	140p
81LS97	120p
81LS98	140p
9601	110p
9602	220p

FERRANTI

ZN425E-8	350p
ZN427E-8	650p

DIL SOCKETS LOW PROFILE

8 pin	9p
14 pin	10p
16 pin	11p
18 pin	16p
20 pin	18p
22 pin	20p
24 pin	20p
28 pin	26p
40 pin	30p

WIRE WRAP SOCKETS

8 pin	30p
14 pin	35p
16 pin	40p
18 pin	50p
20 pin	60p
22 pin	65p
24 pin	70p
40 pin	100p

VOLTAGE REGULATORS

7805	50p
7812	50p
7815	50p
7905	55p
7912	55p
7915	55p
78H05	500p
LM323K	450p

CRYSTALS

32.768KHz	250p
100KHz	300p
200KHz	370p
1.0MHz	320p
1.008MHz	350p
1.8432MHz	250p
2.00MHz	250p
2.45760MHz	250p
3.276MHz	250p
3.579MHz	175p
4.00MHz	200p
4.194MHz	250p
4.43MHz	125p
5.0MHz	250p
6.0MHz	250p
6.144MHz	250p
7.0MHz	250p
7.168MHz	250p
8.00MHz	250p
8.867MHz	250p
10.00MHz	250p
10.7MHz	250p
12.0MHz	300p
16.00MHz	300p
18.00MHz	250p
18.432MHz	250p
19.968MHz	390p
626.690MHz	250p
27.145MHz	250p
38.6667MHz	350p
48.0MHz	300p
55.5MHz	400p
116.0MHz	350p

NANOCOMP MK I

6802 based microprocessor trainer.
Kit £70.00 Built £82.50
P&P £2.00
6800 Reference Manual £4.50

ACORN ATOM

2K RAM + 8K ROM Minimum
Kit £120 Built £150
P&P £3.00
Power Supply (1.8A, 5V) £10.20
P&P £1.20
4K Floating Point ROM £20
1K RAM (2x2114 Low Power) £2.30

	PLUG	SKT
2x32 Way	3.00	4.00
26 Way	3.50	2.65
10 Way	2.20	1.50

ATOM SOFTWARE

Invaders	7.00
Fr. Machine	3.50
Disassembler	3.50
Breakout	3.50
Pinball	3.80
UFO Bomber	3.50

SOFTY (PROM PROGRAMMER AND ROMULATOR)

Mk I (For programming 2708/TMS 2716)
Kit £100 Built £120
P.S.U. £25 P&P £2
MK II (For programming 2516/2716/2532/2732/2764)
Built with PSU £169

UV EPROM ERASER

UV 1B (upto 6 eproms) £42.50
UV 140 (upto 14 eproms) 61.50
UV 141 (upto 14 eproms + Timer) 78.00
P&P £2

IDC HEADERS

10 Way	220
26 Way	350
34 Way	450

IDC PLUGS

10 Way	150
26 Way	265
34 Way	325

IDC EDGE CONNECTORS

26 Way	390
34 Way	450

IDC DIL HEADERS

14 Way	130
16 Way	150
24 Way	280
40 Way	350

EDGE CONS

TYPE	.1"	.156"
2*18W	–	150
2*22W	310	170
2*23W	335	–
2*25W	350	200
1*43W	260	–
2*43W	450	–
1*77W	700	–
S100 Edge Con		400

EUROCONS

DIN41612	
2*32W Plug	300
Skt.	350
2*32W Angled Skt.	400
DIN41617	
31W Plug	160
31W Skt.	160

IDC CABLES

10 Way	65
14 Way	90
16 Way	120
26 Way	160
34 Way	240
40 Way	280
50 Way	330

IDC HEADERS

10 Way	220
26 Way	350
34 Way	450

IDC PLUGS

10 Way	150
26 Way	265
34 Way	325

IDC EDGE CONNECTORS

26 Way	390
34 Way	450

IDC DIL HEADERS

14 Way	130
16 Way	150
24 Way	280
40 Way	350

DIL HEADERS

14W	50
16W	60
24W	100
40W	275

ZIF SKTS

16W	495
24W	600

RIBBON CABLE

20W	120
40W	320

★ SPECIAL OFFERS ★

	1-24	25-99	100 +
2114 450n	95	90	87
2114L 450n	100	95	92
2114 200n	110	100	95
2114L 200n	125	117	110
2716 (+5v)	240	230	210
2532	650	600	550
2732	600	550	500
4116 200n	90	85	75
6116-3 150n	940	900	850

FULL RANGE OF ILP TORROIDAL TRANSFORMERS NOW AVAILABLE FROM STOCK

BOOKS (NO VAT)

Programming the Z80	10.50
6502 Applications Books	10.95
Programming the 6502	10.95
6502 Assembly Language Programming	12.10
TTL Cookbook	7.15
CMOS Cookbook	7.95

P&P £1.00/Book

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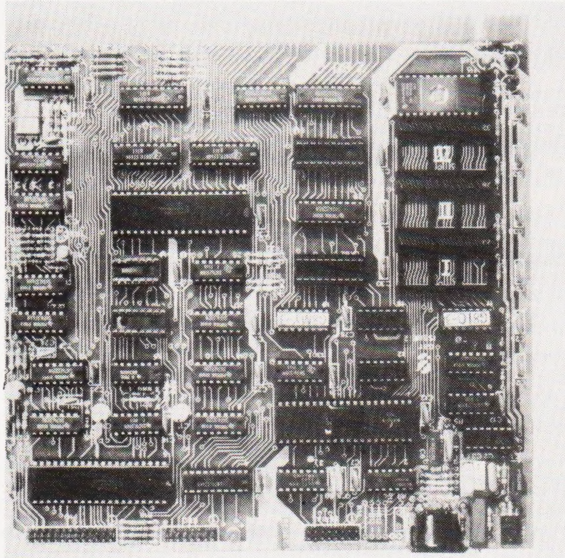
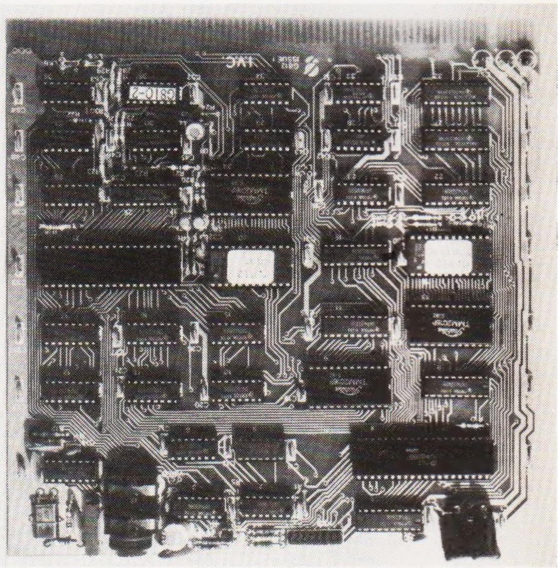
TWIN USERS

For readers who can't afford the £1,200 that a Gemini is likely to cost (see the Business section) they can still take heart from the fact that all the boards produced in the MultiBoard range will plug into their NASCOM systems. In fact they could eventually swop the NASCOM board for the Z80 CPU board (£125) and end up with the Gemini after all! The boards are on an 8" by 8" format and the video section of the system (£140) is on a separate unit, unlike the NASCOM. Other expansion boards include a 4MHz 64K dynamic RAM card (£140), a floppy disc controller (£140), an EPROM card (£70) and an EPROM programmer (£27.50 kit). Enclosures can be a standard Vero rack or the stylish Kenilworth case from Business and Leisure. All the boards and peripherals will be available from the MicroValue group. Further details from Gemini Microcomputers at Oakfield Corner, Sycamore Road, Amersham, Bucks.





BRAIN TRANSPLANT

It finally looks as though the NewBrain will make an appearance on the British market, though not from its originators, Newbury. The British Technology Group has agreed to plough some £230,000 into the venture with Grundy Business Systems doing the production. The product has had a long and stormy beginning with many hundreds of units being ordered before even the first production prototype had been seen. If it had arrived on time it could well have been the computer associated with the forthcoming BBC series on microcomputers but difficulties in both software and hardware delayed it until it could no longer be considered as a viable contender. Grundy estimate that the market price will be between £200 and £300.

MORE EDUCATIONAL

The Schools Council project on Computers in the Curriculum has added software for the TRS-80 Model 1, Level 2 system to their existing range. The current material is for Economics whose topics include International Trade, Multiplier, Fiscal Policy, Elasticity of Demand, Price Fluctuations, Price Stabilisation, Theory of the Firm, Banking and Monetary Policy for which you'll pay £22 including software. The second package is entitled Geography and the individual topics are Human Population Growth, Joint Stock Trading Game, Drainage Basin Morphology, Windmill Game, Farm Game, South Eastern Railway Game and Statistics, which come at £20.80 including software. These packages are already available for the RML 380Z, Apple and PET systems and can be obtained from Edward Arnold (Publishers) Ltd, Woodlands Park Avenue, Maidenhead, Berks, or for further information on the project contact the Educational Computing Section, Chelsea College, Manresa Road, London SW3 6LX.

POSTAL PROBLEMS

Some of you have recently telephoned our offices with enquiries concerning material submitted for publication. The area in which we are situated is currently suffering from delays in the postal system and this, coupled with the fact that we are moving to more spacious offices, has meant that our normal 28-day turnaround of material is being stretched. By the time this issue hits the streets we should be re-housed and back to normal. Please note that this move does not change our address or telephone number.

GO FORTH

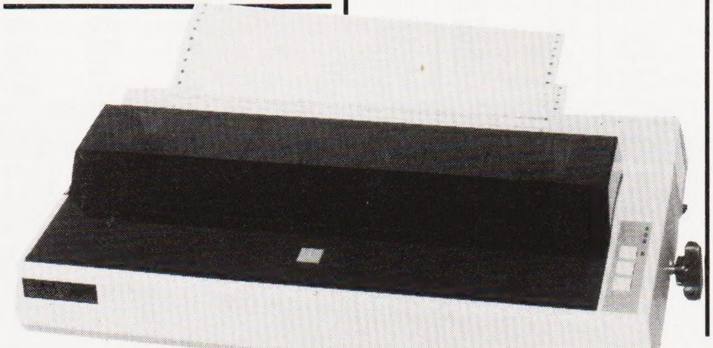
A couple of enterprising people in the Hull area have produced a version of FORTH called HULLFORTH which is suitable for the NASCOM. It can also be used on many other systems provided they have a 300 baud CUTS tape interface and free RAM from 1000H. Details of the necessary modifications are supplied. The package costs £25 and comes with a reference manual and self teaching guide. Further information can be obtained from the authors, A F T Winfield and P S Cain, at 148 Goddard Avenue, Hull HU5 2BP but please enclose an SAE.

MAKING ONE'S MARK

Just too late to be included in last month's Buyer's Guide was a new 136 column printer from Electrographic Peripherals. Printing on a 9 x 9 head with true descenders, condensed and double width characters and a choice of eight country sets as well as the 96 character ASCII set, the printer costs £575. Interfacing is Centronics parallel with a variety of plug-in options also available. Paper handling is tractor or friction and it can print two copies. Further details from Electrographic at Printinghouse Lane, Hayes, Middx.

SET FAIR FOR '81

A one-day show especially for users of the ZX 80 and 81 is being staged in the Library Hall of Central Hall, Westminster on September 26th. Admission will be free and the show will be open between 10.30 and 16.00. All manner of hardware add-ons and software products should be on display together with a Bring and Buy and participation by the User Groups. For further details contact Mike Johnston at 71 Park Lane, Tottenham, London N17 0HG.



QUANTUM JUMP FOR MZ80K

If you are an MZ80K user and fancy some High-Res graphics then a new product from Quantum Micros might be well worth a closer look. Based on a programmable graphics generator it allows you to define your own shapes, reverse any character cell, join up the pixel set, rotate or invert any character and plot to a resolution of 16,384 dots. All that, and more besides, will cost you £150. The main beauty of the system is that it carries its own RAM, your 48K remains yours and if you are not using the High-Res you can use its RAM as well. The circuit fits inside the case and does not affect the I/O units supplied by Sharp. For further information contact Bits & PCs at 4 Westgate, Wetherby, West Yorks LS22 4LL.

Holocaust corrections

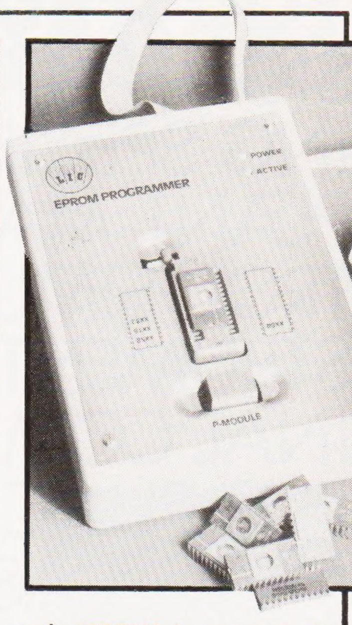
```
230Ø T1>127 THEN AX(CA)=Ø:GOTO 26Ø:REM**KEEPS
     THE WAR GOING AFTER ENEMY ENTERS A RAD ZONE
24Ø IF AX(CA)>Ø THEN POKE VA+AX(CA)+AY(CA)
     *64,6Ø:REM**MAKES THE INVADERS VISIBLE!
38Ø IF AY(T)=Y AND AX(T)=X THEN AX(T)=Ø:
     SC=SC-3Ø:REM**CORRECTS SCORING FAULT
39Ø REM**REMOVE THIS LINE
5ØØ SET(32,V+1):SET(32,V):REM**IMPROVE THE
     RADAR SIGHTS
56Ø RESET(32,V+1):RESET(32,V)
61Ø SET(H+2,1):SET(H+1,1):REM**AS 5ØØ
64Ø RESET(H+2,1):RESET(H+1,1)
11ØØ CH=128:REM**PREVENT ENEMY GOING THROUGH
     CENTRE OF N BLAST
131Ø IF T THEN SC=SC+1ØØ:REM**CORRECT SCORE
132Ø CT=CT+1
```

Wordsquare corrections

```
5Ø DEFINT A-Z:REM**REMOVE SPACE IF UNEXPANDED
     SYSTEM
48Ø IF R2>15 OR R2<1 OR C2>15 OR C2<1 THEN 58Ø
49Ø S$=MID$(W$(W1),I,1)
55Ø S$(R2(I),C2(I))=MID$(W$(W1),I,1)
77Ø PRINT S$(R,C);"[2 SPC]";
95Ø IF S$(R,C)="" THEN LPRINT CHR$(RND(26)+64);
     "[2 SPC]";ELSE LPRINT S$(R,C);"[2 SPC]";
1Ø4Ø FOR A=1 TO LEN(W$(W))
```

LISPED AGAIN

No sooner had our feature on LISP hit the streets than we received note of a CP/M based implementation of the language. Costing a mere £29.50 it is supplied on 8" IBM format media and requires 48K of RAM for operation. Also supplied is a manual, 75 built-in functions, a simple editor and two demonstration programs, one is a simple ELIZA. The same company also offers a C-Compiler at £29.50 and a RATFOR preprocessor at yes, you guessed, £29.50. Further information on all the above from System Science at 54 Enfield Cloisters, Fanshaw Street, London N1.



PROMS FOR PETS

A new EPROM Programmer for direct connection to the Commodore PET has been introduced at £168 by Concordia Automation of 6 Central Road, Worcester Park, Surrey. Because it has its own power supply it connects to just one of the ports. All single supply EPROMS in 24 or 28 pin format between 1K and 8K can be programmed, the type is defined by a plug-in module. Controlling software is available on disc and this allows the user to designate the areas to be programmed. Further product details can be obtained from the above address.

BUG BYTES

If you've been bitten recently by a bug or two the following may sort out some of your troubles. Despite the initial problem of losing the end segment of Holocaust one or two other bugs seem to have crept in as well. Solutions are courtesy of the gentleman from RAF Wittering.

(See above)

Our thanks must also go to Mr Exceeding Patient of Wigan for sorting out a couple of nasties in the Wordsquare program we published in February. We have mentioned some of these before but here's the complete list.

(See above)

The story continues with our August issue and the 6502 Programming Course. The end half of line 890 appears under line 880 instead of in its correct place and there is a 3 missing from the end of line 2000. The rather baffling subroutine between 1810 and 1860 can be removed as it appears to be a hang-over from development days.

HEAVY CROPPER

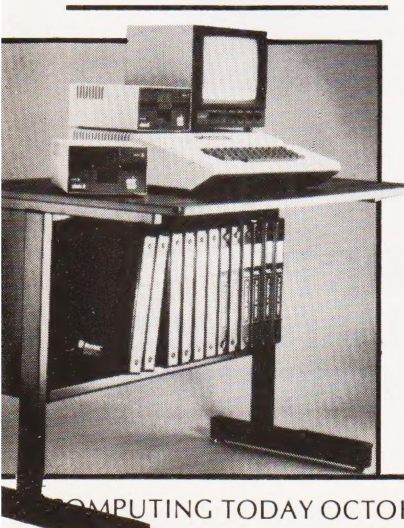
In the two months since its last publication the Apple Software booklet has nearly doubled in size and now includes some 600 packages. There are over 250 new ones, many written by some of the 400 dealers, and of this 250 some 100 are for the educational market. The Software booklet, together with its companion devoted to the hardware available, can be obtained from from Microsense Computers at Finway Road, Hemel Hempstead, Herts HP2 7PS.

SOFTY GETS UPDATE

The SOFTY EPROM Programmer has been recently upgraded to a Mk 2 version. The rather grubby keyboard has been replaced and the unit is now cased rather than supplied as a bare board. For those of you who have not previously encountered the system it allows programming of single-rail 2516, 2716, 2532 and 2732 devices with a TV display in Hex of the contents. Editing can be performed as the information is primarily loaded into RAM and this can be done through either the keypad, a fast cassette interface, a parallel or serial port. Price is £169 plus the ubiquitous VAT and the product and further information can be obtained from Dataman Designs, Lombard House, Dorchester, Dorset DT2 9PL.

MAKING A STAND

In an effort to combat cruelty to VDUs and small systems that have to live on rickety table tops and dodgy desks, Inmac have introduced their VDU stand. Available in two sizes, 30"x 42" and 24" x 36", they are 26" high and cost £80 and £70 respectively. Constructed of welded tubular steel with a laminated walnut finish top, they could provide the answer to every VDU's prayer. For the mobile system they can also be fitted with castors. The shelf illustrated is an optional extra. Inmac reckon it'll take less than 10 minutes to give your system the support it deserves and they will deliver anywhere in the UK within two days. For a copy of their catalogue write to Inmac UK at 18 Goddard Road, Astmoor Industrial Estate, Runcorn, Cheshire WA7 1QF.



IF ANY OF THE FOLLOWING WORDS GIVE YOU A BUZZ . . . ANALYSIS STATISTICS DESIGN PLOTTING GRAPHICS REPORT WRITING SPECIFICATIONS SCHEDULES COSTING PLANT MAINTENANCE PRODUCTION CONTROL SIMULATIONS IEEE INTERFACING INSTRUMENT CONTROL MONITORING TERMINAL COMMUNICATIONS PAPERTAPE READING PUNCHING & EDITING SELF PROGRAMMING BASIC ASSEMBLER LANGUAGE MACHINE CODE . . . GIVE US A BUZZ (OR SEND BACK THE COUPON)

The micro comes of age. The PET has come a long way since micros were regarded as toys. It's designed and built for demanding work and this shows in the 32K memory and 80 column screen as well as in its impressive disk capacity. When it comes to languages, you'll find the PET fluent in BASIC, PASCAL, FORTH, COMAL, LISP, PILOT and ASSEMBLER.

It can be used as a complete system in itself, or can be linked to other PETs or a mainframe.

Who needs PET? And why? The list above speaks for itself, but that's only part of the story as the PET now has over 600 applications. It's good news for any engineer who's tried to get even a modest budget approved – the PET is very acceptable to the most sceptical of money people.

It's an attractive proposition, too, to DP professionals who need their fingers on the pulse and are fed up with waiting for their turn on the company computer.

In fact, it's the nearest thing to the all-purpose computer for everyone. An extravagent claim? A demonstration can prove it to be true.

The PET has track record. We've been involved with electronics for over 20 years and there are now over 40,000 PET installations in the UK.

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What's more, many of our dealers have specific expertise – which means they can advise on anything from business systems to specialist technical applications. So, if your particular problem is of a highly specialised nature, it may be best to contact our Information Department direct. They will then recommend the dealers who understand – and who speak your kind of language.

What does all this cost? Not a lot. In fact, our computers start at £200 and go through to £3,000 – and that will buy you a complete system.

Which is just one more reason why any professional worth his salt would be interested in a microcomputer that's made its name in the business world . . . but is far more than just an efficient business brain.

Send to: Commodore Information Services, P.O. Box 109, Baker Street, High Wycombe.
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I'd like to know how a Commodore PET could give me a buzz.

Name ....

Company ....

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Tel: ....

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Chromasonic Electronics
N19, 01-263 9493/9495
Healey Management Services Ltd
E1, 01-247 2858/3149
Home and Business Computers
E12, 01-472 5107
Logic Box Ltd
SW1, 01-222 1122/5492
Merchant Systems Limited
EC4, 01-583 6774
Metyclean Ltd
EC4, 01-236 2000
Micro Computation
N14, 01-882 5104
Micro Computer Centre
SW14, 01-878 7044-7
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EC1, 01-628 3531

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BRACKNELL, 52929
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Dataview Ltd
COLCHESTER, 865835
DaVinci Computers Ltd
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HAMPTON HILL, 01-979 4546
Cream Computer Shop
HARROW, 01-863 0833
L & J Computers
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Bromwall Data Services Ltd
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Camden Electronics Limited
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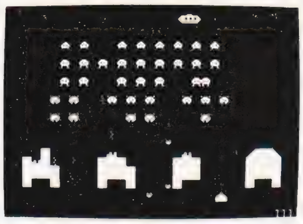
All Acornsoft games are designed and produced by the manufacturers of the Atom. Trust the manufacturer to get the very best out of his product. Realistic sound effects, great graphics and colour too!



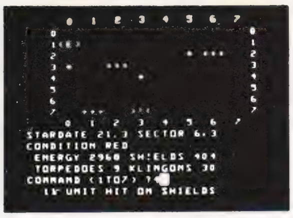
SPACE INVADERS
This has proved to be the most popular video game ever. And now we've brought it right up to date. Different, types of invaders, flying saucers, shelters, laser guns and full sound effects. Program 5K, graphics 6K
Also in Games Pack 5
Wumpus + Reversi

GAMES PACK 1
Asteroids Shoot them before they crash into you. Lists ten best scores. Program 4K, graphics 6K.
Sub Hunt Command a destroyer tracking a submarine, find its position and destroy it. Program 1K, graphics ½K, needs floating point.
Breakout Score points knocking bricks from wall. Ball has two changes of angle and speed. Program 3K, graphics 1-2K. COLOUR

GAMES PACK 2
Dogfight Two-player game each player controls a plane and tries to shoot down his opponent without crashing. Program 4K, graphics 6K.
Mastermind Guess the computer's code before the computer guesses yours; program 3K, graphics ½K.
Zombie Land on Zombie island; try to lure all the zombies into the swamp. In desperation jump into hyper-space! Program 3K, graphics ½K. COLOUR

GAMES PACK 3
Rat Trap Move your rats without colliding with the trails left. Entangle your opponent before he entangles you! High-speed rat action-replay. Program 4K graphics 6K.
Lunar Lander Land a spacecraft on a lunar crater; altitude velocity, fuel and drift. Program 1K, graphics ½K.
Black Box Deduce the position of four invisible objects in the Black Box by firing rays at them. Program 4K, graphics ½K.

GAMES PACK 4
Star Trek Classic computer game, rid the universe of Klingons. Short and long-range scans, galactic map, phasers, photon torpedoes, shields, etc. Program 5K, graphics 2K.
Four Row Take turns in placing marbles on the board; the first to get a line of four wins. Program 5K, graphics 6K. COLOUR
Space Attack Repel the invasions of earth and avoid being hit by the gunner ships. Becomes progressively harder with each invasion. Program 3K, graphics 6K.



GAMES PACK 6
Dodgems Steer your car and avoid the computer-controlled car programmed to collide. Survive, and the game gets faster. Program 4K, graphics 6K.
Simon Test your ability to remember a progressively longer sequence of lights and tones. Adjustable skill level. Program 2K, graphics 3K. COLOUR
Amoeba Try and create the shapes devised by the computer. Program 3K, graphics 3K.

GAMES PACK 7
Green Things An alien life-form has invaded your spacecraft; discover a way of destroying it with the weapons available on the ship. Program 5K, graphics 2K. COLOUR
Ballistics Take turns in firing shells at the other player, taking into account the wind and shape of the hill, Program 3K, graphics 6K, needs floating-point.
Snake Grow yourself a snake by guiding it towards digits which it eats. Program 2K, graphics ½K.

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Or if you think you can wait for more details just write to
Acornsoft Limited, 4a Market Hill, Cambridge.

ACORNSOFT TAKE GAMES SERIOUSLY

ON COURSE

A two-day conference on Computer Aided Manufacturing and Productivity is being organised by the Institution of Production Engineers and the Society of Manufacturing Engineers (USA) at the Mount Royal Hotel, London, on 21st/22nd October. Non-members will have to find £150 for the event, members £130; prices include food and documentation but not VAT. For registration details write to The Manager, Conferences and Exhibitions, IProdE, Rochester House, 66 Little Ealing Lane, London W5 4XX. Mills and Allen Communications are running two one-day seminars on 21st and 22nd September, the first on Private Viewdata and the second on Gateway Applications. Both are being held at the Royal Garden Hotel in Kensington and you can obtain details from Paul McFarland, Mills and Allen Communications, 1-4 Langley Street, Long Acre, London WC2E 9JY or ring him on 01-240 1307. A one-day seminar on Micrographics and the Video Challenge will be held on 27th November at Sudbury Conference Centre. Further information and registration details from Microinfo, Newman Lane, Alton, Hants GU34 2PG. If you have three days and £149 (plus VAT) then Cambridge Micro Computers will teach you to program in BASIC. The course is supported under the MAP scheme and details of the dates and times can be obtained from the company at Cambridge Science Park, Milton Road, Cambridge CB4 4BN. And finally, on 3rd December, the Cambridge area of the IEE are running a one-day seminar on Practical Software Engineering for Microprocessor Systems. The event takes place at Cambridge University and details can be obtained from C Coffin, 18 Cherry Close, Milton, Cambridge CB4 4BZ.

ACCOUNTING FOR ITT

ITT Consumer Products have announced a package for their 2020 version of the Apple, called the Accountant. The program records transactions, analyses sales and purchases, does VAT and keeps track of names and addresses. The hardware overhead is 48K of RAM with three floppy drives and a printer. Development cost of the package is estimated at some £200,000 over 18 months and the complete system with software will be selling for around £4,000. Further information is available from ITT Consumer Products at Chester Hall Lane, Basildon, Essex.

DESK BOUND

Paxton Computers are re-launching their Business Desk package, written in CIS COBOL at a starting price of £300. Running under CP/M it is currently implemented on, among others, PET, Apple, North Star, Superbrain and Cromemco kit. The modular package allows expansion from a basic accounts package to include facilities such as stock control, on-demand reporting and enquiries all controlled by single inputs to the system. An illustrated brochure on the package is available from Paxton at 28 New Street, St Neots, Huntingdon, Cambs PE19 1AJ.

ALPHA ADAPTATION

The ever-rising star of the adaptor world, Tantel, is now to be fitted with an alphanumeric keyboard, primarily for the Granada TV Rental chain but also for public consumption. If you've already got one and don't want to trade it in for the new model, Tangerine are producing a new ROM which will allow personal computer users to connect their system to the adaptor. This makes possible a number of previously unavailable functions such as actually using the information, mass storage of oft-used information and full alphanumeric keyboarding for the message service. For information contact Peter Harding at Tandata Marketing, Forehill Works, Forehill, Ely, Cambs CB7 4AE.

TWIN CPUS FOR HP

The latest Hewlett Packard office computer, the HP125, uses twin Z80A CPUs to create a system capable of handling the workload of a medium-sized business. The system features 64K of RAM, dual discs in either 5¼" or 8" formats, graphics capability for handling packages like VisiCalc/125, and the potential to be connected to other systems through communications ports. The pricing structure starts at £4,372 for a system with twin mini floppies, two RS232 ports and an integral 120 cps thermal printer. The software all operates under the CP/M system with packages selling from £118 for VisiCalc to £293 for Word/125. A BASIC interpreter is available (£191) as is an advanced programming package (£44) which includes Assemblers and the like. Further information can be obtained from the Business Computer Systems Group, King Street Lane, Winnersh, Wokingham, Berks RG11 5AR or by ringing Wokingham 0734-784774.

BRITISH TWINS

The Gemini desktop system announced at the end of last year is to be manufactured by a new company called British Micros. Formed by a partnership of John Marshall, the man who brought you the NASCOM and Manus Hegoyan, the man who wanted to buy Nascom, they will start to produce demonstration models in August with the full production coming on-stream by the end of the year. Designed around the MultiBoard range of cards with a Z80 CPU and twin 5¼" drives, 64K of RAM and High-Res graphics, the system will sell for just under £1,200. Software operates under the ubiquitous CP/M and there is a 24K Microsoft BASIC implementation supplied. COBOL and FORTRAN will follow and plans to introduce APL are afoot. For technical information contact British Micros at Unit Q2, Penfold Works, Imperial Way, Watford, Herts or ring them on Watford 48222.

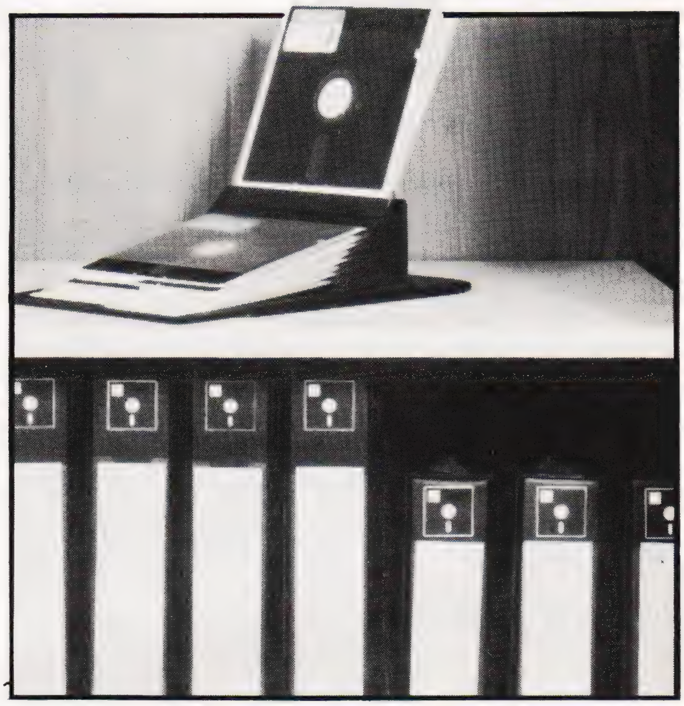
BUSINESS NEWS

ALL TRUSSED UP

Well, we hope not because this is Durango, the portable business system from CAL. Weighing in at 65 lb and selling for some £4,995, it is proving to be very popular. Software can be written in BASIC, Multi-tasking BASIC and COBOL and the unit is complete with printer, dual discs and VDU. For details on how you can build up your muscles by lugging one around drop CAL a line at 64 High Street, Egham, Surrey or give them a ring on Egham 36455. Nice place, Egham, but I wish they'd finish that motorway!

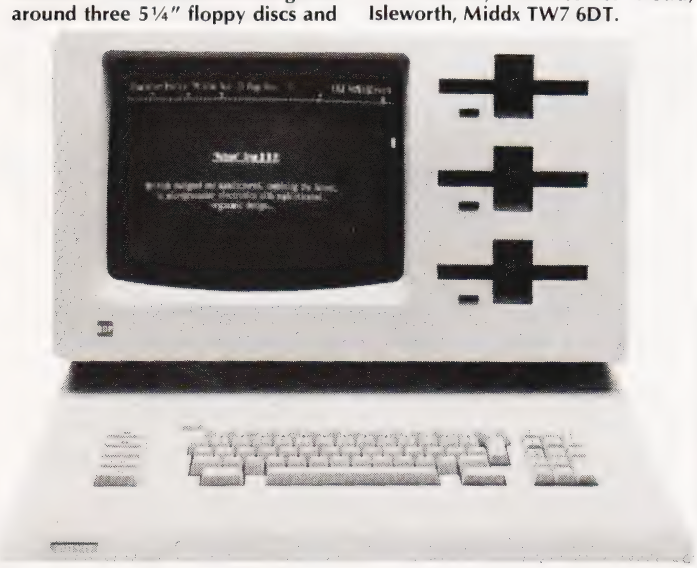
SHELVE 'EM

If you have a storage problem with all those floppy discs that your system seems to generate, then why not simply file them? Latest in a long range from Flexiform are shelf filing binders for floppy discs that convert into display stands for use at the work station. Available in both sizes, 5¼" and 8", they come in a wide choice of colours — black, noir, nero, negra and schwartz! They each hold 20 discs. Information on these and the other products made by Flexiform can be obtained from them at 16 Duncan Terrace, London N1 8BZ.



TRIPLE DECKED

On the grounds that Britain may not always be first in the field but generally produces the goods in the end, it is worth taking a look at a new word processor from Thos Hill. A complete package sells for £4,750 and goes under the name of Vutype. It was designed and produced by BDP (Word Processing), a subsidiary of Thos Hill, and the software includes arithmetic functions as well as the usual document processing features. The hardware is configured around three 5¼" floppy discs and text display is on an orange phosphor VDU. There is a choice of three daisywheel printers to go with the system or you can connect it through a communications port to another word processor or phototypesetting equipment. As a further option the system can be fitted with the Intype device which allows most makes of electronic or golfball typewriters to be connected as terminals. For more detailed information write to the Information Processing Division at Hill House, Clocktower Road, Isleworth, Middx TW7 6DT.



SEEING INTO THE FUTURE

The soon-to-arrive optical disc systems are already being tacked onto personal computers. The Apple has already been demonstrated with an optical player by Personal Computers who are intending to market the unit at around £1,500, with media at about £5 per disc. The only trouble is that it is currently a Read Only system but it is capable of holding vast amounts of information. Personal Computers see the products as a training medium with the Apple being used to control the system. Other companies see the video disc as forming the basis of complete systems, taking the place of ROMs in effect. For information on the product contact Personal Computers at 194-200 Bishopsgate, London EC2M 4NR.

ON A WINNIE(R)

Texas, having just announced their withdrawal from the bubble market, are blowing the trumpets over their entry into the Winchester technology ballgame. The new 5¼" disc stores some 6.38Mb of unformatted information and gives an average access time of 170 mS with a typical transfer rate of 5Mb/S. Based on the stepper motor system of head control the unit carries its own control electronics and is fully sealed against the operating environment. Prices are expected to be around the £970 mark with quantity discounts to OEM houses. There are some units currently in the field under evaluation and volume production should be under way by the end of the year. More information can be obtained by writing to Texas Instruments at Manton Lane, Bedford MK41 7PA.

UK101 - OHIO - SHARP - MICROTAN -

WORD4WORD

stunning new TRS80/VG Word Processor

Why pay £75-£150+ for a Word Processor? WORD4WORD gives you all the facilities you could wish for in a WP for a sensible price.

Amongst the features included are:

- FULL SCREEN EDITING & TWO-WAY SCROLLING
- FULL TEXT INSERTION/DELETION ANYWHERE ON SCREEN
- GLOBAL SEARCH AND AMEND
- TEXT SEARCH - TOTAL TEXT MOBILITY
- TEXT FORMATTING TO SCREEN OR PRINTER
- CASSETTE STORAGE OF TEXT
- VISION LOAD OF STORED TEXT FROM CASSETTE
- STANDARD LETTER ROUTINES
- TABLE GENERATION
- PAGE LAYOUT AND NUMBERING
- COMPREHENSIVE PRINTER CONTROL
- TEXT HIGHLIGHTING FOR U/L CASE RECOGNITION
- FILE HANDLING ON CASSETTE AND DISK

MANY OTHER FEATURES ARE INCLUDED IN WORD4WORD. WE WOULD NEED SEVERAL PAGES TO DO JUSTICE TO THIS SUPERB PRODUCT! WORD4WORD IS COMPARABLE TO MOST PURPOSE BUILT WP SYSTEMS. AVAILABILITY IS IMMEDIATE. COMMISSIONED AND DEVELOPED BY PREMIER PUBLICATIONS - NOT AN IMPORTED PRODUCT.

PRICE: CASSETTE £33.95, DISK £37.95

✻SOFTWARE✻

MICROTAN CATACOMBS - STRATEGY GAMES - GAMBLING GAMES - UTILITIES - AIR/SEA BATTLE - ADVENTURES - CODEBREAKER - SCRAMBLER

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CEGMON now only £25.87

TOOLKIT 2 for TRS 80 and VIDEO GENIE

TOOLKIT 2 now features 17 new easy-to-remember command words which greatly enhance an already powerful BASIC, and gives you a machine code monitor for the first time:

REPLACE allows you to find and replace any string, word or variable in a BASIC listing.
VARS gives a list of variables on screen.
TRACE displays the WHOLE line of BASIC during operation.
ABBREV allows you to define 26 BASIC words as single-key entries.
RENUMBER will operate from any start in any increment.
BLANK removes unwanted spaces and LET from your listing.
VTAPE allows vision loading (see below for full details).
MC - a full machine code monitor.
Other words are ***VARTRACE, PAGE, OLD, DUPL, FIND, LFIND, LVARS, LREPLACE, REMKIL***

PRICES: CASSETTE £29.95, DISK £32.95, FLOPPY TAPE £31.95. P&P: Cassette/Tape 60p, Disk £1

VTAPE an answer to a problem for TRS80/VG owners

At last you can watch your tapes load properly, and check your program as it goes in! VTAPE shows ALL the BASIC lines (except the line number) as they are being loaded. BASIC words are correctly displayed - they do NOT appear as graphics. Adjustments for tape input level etc, can now take a few seconds instead of hours. Problems can be spotted quickly and easily.
Also APPENDs BASIC programs. PRICE: £7.95.

TWO-TO-TAPE

Superb new utility for TRS80/VG (non-disk) giving you total control over TWO cassette decks.

SYSTEM command extended to both cassette decks.
Extended LOAD commands (auto execute, filename override).
Screen can be saved to and loaded from tape.
Tape analysis routine for many common formats.
Compatible with TOOLKIT 2. Uses only 1K of code.
All commands to either deck.
Suitable for Video Genies and expanded TRS80.

PRICE: £19.95, or send for more details.

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SOFTWARE NOW AVAILABLE

ZX81 ZX80

PREMIER, Britain's leading hobby software specialist, announces a new range of TOP QUALITY programs for the ZX80/81 computers, all on cassette with full user documentation, fully tested before release and all original games commissioned by PREMIER to the highest possible standards. Send SAE today for a full list of software available.

TRS80-V.GENIE-and now ZX80/81

BASIC 5 - for UK101 and OHIO

The most devastating enhancement yet, adding 17 new BASIC words to your interpreter which can be used in program lines and give machine code response speed to graphics and formatting!

PRINTUSING, HLIN, VLIN, SCR, BLK, SET, TEST, GET, GS, GT, GO, GO$, RD, PRINTAT, INAT, WI, CWI

Graphics - HLIN, VLIN, SCR, BLK, SET and TEST allow generation and manipulation of graphics at speeds which are unimaginable in BASIC.
Formatting - PRINTUSING, PRINTAT and INAT allow total control over screen output.
Programming - GET (key), RD (READ DATA), GS & GT (GOSUB and GOTO a variable), GO & GO$ (GOTO a machine code routine), allow total program flexibility.
WI and CWI allow CEGMON users to manipulate their screen under variable control using one command, in hex or decimal.

BASIC 5 is available for CEGMON and MONO2 ONLY. STATE precisely your computer and monitor when ordering. Comes complete with comprehensive manual.

PRICES: DISK £17.95, EPROM £19.95, P&P: DISK/EPROM £1

TES 2 *NEW LOWER PRICES!*

8K RAM board (for 16 x 2114)
8K EPROM card (for 4 x 2716)
Motherboard + PSU
- all above: kit £29.95, built £39.95
Mini ROM/EPROM board: kit £14.95, built £20.95
J1 Buffer board: £19.95, built £29.95
Screen Enhancement Kit: £49.95, built £64.95

MINI EPROM BOARD

Takes all your BASIC chips (ROM or EPROM) off your main board and on to our Mini EPROM board, then plugs into BASIC 4, leaving three slots on the main PCB for EPROMS of your choice.
As an introduction, we are selling this board at the low price of £14.95 (kit) £20.95 (built)

BASIC 4 Cassette File Handling System

This new EPROM for the UK101/OHIO range provides a comprehensive file handling system, capable of working at up to 4800 baud.

* Named programs to cassette
* Verify tape contents facility
* Reliable high-speed save/load
* Selectable auto-run of loaded BASIC/MC program
* Crash recovery command
* Seven new save/load commands
* Fully compatible with existing software

PRICE: £11.95

CODEKIT

A COMPLETELY NEW, ORIGINAL LINE ASSEMBLER/ DISASSEMBLER/EDITOR FOR THE UK101/SUPERBOARD

Immediate availability on all versions.

Please note: CODEKIT will run under the following monitors only - Original Superboard monitor, both Compshop monitors and the logical upgrade, CEGMON.

PRICES: Tape £14.95, Disk (5¼") £17.95,
EPROM £19.95, P&P: Tape 60p, EPROM/Disk £1.

INVADERS

Quite simply the best machine code game ever written for the UK101. Premier have succeeded where others have failed. Our Invaders is faster than any version we have yet seen, including arcade machines. Warning! It's completely unplayable at 2mhz.

Invaders has all the features you expect, plus superb graphics and two-player option. PRICE: £7.95

SPECIAL OFFERS!

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CODEKIT (in EPROM) + Mini EPROM Board - £29.95
BASIC 5 (in EPROM) + Mini EPROM Board - £29.95

POSTAGE and PACKING: Software 60p per order, EPROMS £1 per order, Hardware £1.50 per item (maximum £3). Catalogue FREE CT10

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Premier Publications

12 Kingscote Road Addiscombe Croydon Surrey Telephone 01-656 6156

Simon Goodwin

Using a more efficient coding system gives you more room for words

Many of the common applications of microcomputers involve the storage of large amounts of text : mailing lists, multiple-choice tests, and role-playing games (such as Adventure) are obvious examples of this. For the user without a disc system, access to this information can be a tedious business — the size of a data base must either be restricted by the RAM space available, or slow and unwieldy cassette files must be used. In this article I will present a set of programs adaptable for most BASIC micros which allows an increase of up to 50% in the amount of text that can be stored in RAM. No more question numbers stored in the screen border memory — no more monster tables in the second cassette buffer...!

The example programs should work, without much alteration, on any machine with an eight-bit data bus and facilities to manipulate strings (lines of text) and handle integers of values up to 64,000. The example programs were written on a 16K Video Genie and should therefore run unmodified on a TRS-80 Level 2. With minor changes they have also been found to work on an Apple 2.

The ASCII Problem

Wastage occurs whenever ASCII text is stored in an eight-bit byte of memory. 256 codes can be stored in eight bits (each bit, or Binary digit, can have two values, either zero or one; two multiplied by itself eight times is 256). Most text only requires 50 or 60 different codes — numerals, upper and lower case text, and a few punctuation characters. The first program allows the storage of capital letters, numbers, spaces, commas, question marks and full stops. The format is approximately 50% more efficient than ASCII code. As many micros cannot display lower case letters this program will be adequate when space is at a premium — it doesn't include zero since a letter 'O' will suffice when calculations are not required.

There is no reason why a different character set should not be used with the program as written — provided it is no more than 39 characters long. If this number of characters is an unacceptable limitation, the second and more complex routine allows up to 76 different ones to be stored in a format only slight less dense. In the meantime let me explain the basic principle used.

Bits of Bytes

The system stores three characters in every two bytes of memory. This can be done because two bytes permit 256 x 256 = 65,536 different codes to be stored. Three characters of up to 40 different types take up 40 x 40 x 40 = 64,000 of the codes — the standard 96 character ASCII set only uses 96 x 96 = 9,612 of them. In practice, to avoid using the zero code (which would complicate the program) only 39 different character types are encoded. It tests each letter in the ASCII string entered to check that it is one of the chosen set. If it finds a character that it can't encode it prints out the string entered, with a question mark beneath the illegal character.

To use the program type in the first listing as shown, with the encode and decode sections included. Try it out by entered as shown — on a Video Genie screen the corresponding function is represented by a square bracket, generated by pressing the ESC key. If you want to use commas in your entry you will have to use LINPUT or INPUT LINE in line 30040, or a loop using GET or INKEY$ to scan the keyboard.

Don't worry if the encoding routine seems rather slow — it can take up to 10,000 iterations for a 'worst-case' string of 250 letters to be compressed. The speed can be increased considerably if the most common characters are placed at the start of A$ (the legal set), but in general the machine should be able to encode faster than you can type. The decoding routine is much quicker, typically 40 times as fast, and the slow encode should only need to be used once.

```
30000     CLEAR 1000:CLS
30010     REM**CONSTANTS USED BY BOTH PROGRAMS
30020     S1$=CHR$(32):A$=S1$+"123456789ABCDEFGH
          IJKLMNOPQRSTUVWXYZ.,?"
30030     REM**TEXT ENCODER MK 1
30040     INPUT L$:L=LEN(L$):S=INT((L+2)/3)*3:R$="":
          L$=L$+S1$+S1$
30050     FOR J=1 TO S STEP 3:V=0
30060     FOR I=0 TO 2:C$=MID$(L$,I+J,1):K=1
30070     IF C$=MID$(A$,K,1) THEN 30060 ELSE K=K+1:
          IF K>39 THEN 40080 ELSE 30070
30080     V=V+K*(40^I):NEXT I:R$=R$+CHR$(V/256)+
          CHR$(V-INT(V/256)*256)
30090     NEXT J:PRINT"ENCODES AS : ";R$
40000     REM**TEXT DECODER MK 2
40010     L=LEN(R$):F$="":FOR J=1 TO L STEP 2:
          V=ASC(MID$(R$,J,1))
40020     V1=ASC(MID$(R$,J+1,1)):V=V*256+V1:C3=INT(V/1600):
          V=V-C3*1600
40030     C2=INT(V/40):C1=V-C2*40
40040     F$=F$+MID$(A$,C1,1)+MID$(A$,C2,1)+MID$(A$,C3,1):NEXT J
40050     PRINT"DECODES AS : ";F$
40060     STOP
40070     REM**ILLEGAL CHARACTER USED BY ENCODE
40080     PRINT"ERROR : ";L$
40090     PRINT TAB(7+I+J);"?"
40100     PRINT"LEGAL CHARACTERS: SPACE";A$
40110     END
```

Program 1. The basic encoding routine in BASIC!

entering a string and checking that it decodes alright. Don't worry if some of the characters printed after 'ENCODES AS' look rather weird — they may include graphics, reverse video or flashing letters depending upon the machine that you are using. Provided that the text after 'DECODES AS' is the same as that you entered in the first place, all is well. The 'up-arrow' symbol in line 30080 indicates that the number preceding it is raised to the power of the one following it. On an Apple this can be

When you are satisfied that the program works you can modify it to allow more than one encoded string to be stored — either dump R$ into a string array, write it out temporarily to cassette, or POKE it into reserved memory if you're feeling particularly adventurous. An integer array can be used to store the addresses of the condensed strings. Once you have entered the text all lines of the routine except 40010 — 40040 can be deleted. It's a good idea to store the data on cassette *before* you delete the lines — variables are cleared when the program is changed. Still, Rome wasn't burnt in a day. . .

How It Does It

The next step is the entry of the main part of your program in the usual way. Whenever you want to display some encoded text the program should read it into the variable R$. Then call the routine from line 40010 onwards, which should (all being well) re-assemble the source string, 50% longer, in F$. The only constant required is A$, containing the chosen character set. It must be the same one as was used when the encoding took place, or the text will be garbled. The routine requires a very small memory overhead (though after reading this far you could be forgiven for thinking otherwise!). Since the decoding section contains no line-number references it can be reduced to a single multi-statement line if spaces are omitted. On a Video Genie the resident decoding section only took up 161 bytes, plus, at most, 200 bytes of extra string space. On a 16K machine it made it possible to store an extra 780 place names in a multiple-choice test program.

When saving the finished program it is necessary to save the entire block of program workspace onto tape, to avoid losing the data. If you have no monitor facility with which to do this then the condensed data could be POKEd into REM or DATA statements and saved with the program.

A Second Helping

There is an alternative approach to the storage of text which may have occurred to those of you with obsolete terminals or portable typewriters. Back in the Dark Ages before Dot Matrices (?), Golfballs (??) and Daisywheels (curiouser and curiouser), printers and terminals used to have cast metal heads with the letters individually formed on their surfaces, much like the works of a portable typewriter. The problem was that without the ingenious modern print head systems there was a fairly definite limit to the number of characters that could be fitted onto a single small metal drum at a level where they could hit the paper (or be hit by the paper) without too many mechanical contortions. This limit turned out to be about 30 — rather less than the number of characters that the machine was required to print. Consequently they used a five-bit code allowing 32 options, and set aside some of the codes to act as a 'shift', mechanically changing the set of characters that could be printed. This system was called Murray or Baudot code, for reaons probably best know to Murray and/or Baudot. . .

This program is similar to the first in that it give a character a code corresponding to its position in a string of legal characters. It then does some arithmetic to convert three of these codes into a number that will fit into two bytes. The new program applies the Murray code solution to the limitation on the number of characters that can be stored. It uses the same 39 codes but reserves the last code for changing the character set in use, like the shift lock key of a typewriter. When text is entered it checks whether the first character it encounters is in the current set. If so, it records the code as normal, if not it swops over the set in use with an alternative one, and stores a code 39 to tell the decoding program that it has changed sets, followed by the position of the character in the alternative set. Hence the program is almost as efficient as the 39 character one — it uses only ⅔ byte for each character — except when the next character is from a different set to the last one, when it uses 1⅓ bytes, actually less efficient than ASCII.

In practice, if the character sets are carefully chosen, the overall effect can be a marked reduction in the amount of space needed to store text on a micro, by comparison with ASCII code. Groups of characters likely to be used in close proximity are stored in the same set — numerals, capitals, lower case letters for example. The most common characters, space and comma, are included in both sets in the program shown, to try to reduce the number of set-changes needed, but that need not be the case. In fact any two strings of 38 characters could be used in A1$ and A2$, allowing you to choose the characters which you wish to include for your own application.

To use the program type in the second listing shown, with the encode and decode sections included, try it out by entering a string and checking that it decodes alright. Don't worry if some of the characters printed after 'ENCODES AS' look rather weird, provided that the text after 'DECODES AS' is the same as that entered, all is well. The 'up-arrow' symbol in line 30130 is as described previously, not to be confused with the CT codes. If you want to use commas in your entry you will have to use LINPUT or INPUT LINE in line 30070, or a loop using GET or INKEY$ to scan the keyboard. The encoding routine may again seem rather slow — it can take up to 20,000 iterations for a 'worst-case' string of 250 letters to be compressed.

Although this routine requires rather more space than the first, the memory overhead is still quite small by comparison with the amount of space saved in a program containing large amounts of text. On a Video Genie the decoding routine took up only 246 bytes of program storage, plus about the same again in extra string space needed. Using the index strings shown this overhead would be more than compensated for by the extra space made available in any program using more than about 1200 bytes of text, and on a simple program such as a test it can be expected to increase the amount of text space available by 30-40%, all in software.

```
30000    CLEAR 1000:CLS
30010    REM**ARRAY USED IN DECODE
30020    DIM C(3)
30030    REM**CONSTANTS USED BY BOTH PROGRAMS
30040    S1=CHR$(32):A1$=S1$+"123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ
30050    A2$=S1$+"+-=&)(':;abcdefghijklmnopqrstuvwxyz?,"
30060    REM**TEXT ENCODER MK 2
30070    INPUT L$:L=LEN(L$):A$=A1$:R$="":J=1
30080    S=L-INT(L/3)*3:IF S=0 THEN 30100
30090    FOR I=1 TO S:L$=L$+S1$:NEXT I
30100    V=0:FOR I=0 TO 2:C$=MID$(L$,I+J,1):K=1
30110    IF C$=MID$(A$,K,1) THEN 30130 ELSE K=K+1:
         IF K>38 THEN 30120 ELSE 30110
30120    L$=LEFT$(L$,I+J)+RIGHT$(L$,LEN(L$)+1-I-J):
         IF A$=A1$ THEN A$=A2$ ELSE A$=A1$:K=39
30130    V=V+K*(40^I):NEXT I:R$=R$+CHR$(V/256)+
         CHR$(V-INT(V/256)*256)
30140    J=J+3:IF RIGHT$(L$,J)<>"" THEN 30100 ELSE
         PRINT"ENCODES AS : ";R$
40000    REM**TEXT DECODER MK 2
40010    L=LEN(R$):F$="":A$=A1$:FOR J=1 TO L STEP 2:
         V=ASC(MID$(R$,J,1))
40020    V1=ASC(MID$(R$,J+1,1)):V=V*256+V1:
         C(3)=INT(V/1600):V=V-C(3)*1600
40030    C(2)=INT(V/40):C(1)=V-C(2)*40
40040    FOR K=1 TO 3:IF C(K)<>39 THEN F$=F$+MID$(A$,C(K),1):
         GOTO 40060
40050    IF A$=A1$ THEN A$=A2$ ELSE A$=A1$
40060    NEXT K:NEXT J
40070    PRINT"DECODES AS : ";F$
40080    END
```

Program 2. The more comprehensive character set is program selected

computing today

NOVEMBER 1981

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COMPUTING TODAY · NEXT MONTH

ON T' TELLY

The domesticated television set is no longer the simple device of Baird's dreams. It doubles up as a personal computer terminal, video games display and home movie projection system. To add to its workload there is the Teletext information system, the first of the two main information networks that we'll be taking a look at over the next couple of months. How the system has developed over the last five years and what its future is likely to be are just two of the topics to be covered in the next issue of CT.

A CRACKING SUCCESS?

Triumph Adler's new small system, the Alphatronic, certainly looks to be a winner on paper. It has inspired a number of software houses to produce business oriented packages for it but it could also fit into the serious personal market too. Our reviewer has been using the system for an extended period and reveals his discoveries about its strengths and weaknesses as a machine for serious use.

YOUR FIRST BYTE?

Judging by the amount of correspondence we receive from people who read the magazine but who don't yet own computers, there seems to be a need for an introductory series to computer programming. Starting next month we present just such a series which, in catering for the complete novice, will introduce simple programming techniques plus a few clever tricks for the more advanced computerist.

SPEAK UNTO ME

Some months ago we reported on the National Semiconductor's DIGITALKER system. There are now several complete systems that use this chip set for low-cost speech synthesis, and next month's Special Report takes a look at one such unit produced by a new British company. The unit has plug-in compatibility with one of the most popular personal computers as well as having optional interfaces for many of the other machines on the market.

ANSWERING BACK

In conjunction with our new series for beginners we are also starting up a Question and Answer page for reader enquiries. This does not replace our usual technical enquiry service but is intended to highlight simple, common problems that occur with many of the personal computers. If you have an enquiry that you'd like answered in print, send it in to our Q&A page. We don't guarantee that they will all be used but we'll certainly do our best!

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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PET HI-RES!

If you're a PET owner then there must have been a few occasions when you wished that it had the graphics capabilities of the APPLE.

Of course there has been a high-resolution board around for some time — but only now can you buy one for under £300. The HR-40 HIGH RESOLUTION GRAPHICS BOARD offers maximum possible resolution (320 by 200), but costs just £149 plus VAT, half the price of the competition! Because the HR-40 board was designed and manufactured in Britain we've been able to keep the price down without restricting its capabilities. And if you're really hard-up and a dab hand at soldering you might prefer to wait for the kit version (due later this year) which will cost £99 plus VAT without software.

The assembled board is supplied with 8k of RAM and utility software in EPROM, so that PET's own RAM is entirely available to the user. Though the graphics RAM uses addresses normally represented by the ROM sockets UD3 and UD4, these sockets are duplicated on the HR-40 board and are software selectable. The board may be installed WITHOUT SOLDERING OR TRACK-CUTTING!

At present the board will fit a standard PET or CBM computer with the nine inch screen, but we hope to have a version for twelve inch models very soon. Write or telephone for more details and up-to-date information.

SUPER GLOOPER

First in our new range of ARCADE style games for the PET, SUPER GLOOPER will have you on the edge of your seat. Your task is to clear the screen of little dots scattered in a maze, but WATCH OUT FOR THE GLOOPER EATERS, they're liable to escape from their pen and come after you.

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METEORITES

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SUPERSOFT arcade games are written in machihne code for speed and run on all 40 column PETs with BASIC 2, 3 or 4. At just £8 plus VAT, they're really good value and you won't find a more exhilarating game at any price! We've more great games on the way — including some for the 8032 and VIC-20!

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POOLS PREDICTION

D S Peckett

Having shown you the theory we now present the program

In last month's article I described the theory behind a program, written in Level II BASIC for a TRS-80 or Video Genie, that attempts to predict the draws which will occur in each week's English and Scottish Football League matches. If you did not read the article, write in now for a copy of the September '81 issue of CT.

This month, I will give you a listing for the program, explain how each part of it works, and describe how you should use it each week. First, though, let me remind you of the program's key points.

The program should, with only a small amount of luck, help you to win several pools dividends each season. In general, the wins will be fairly small — a scientific approach has no hope of producing a really big win — but should leave you in pocket at the end of the season. *Please note:* wins are *not* guaranteed!

The Technique

The basic technique is to look at the recent form of the teams in each match and see what happened before when any teams with similar form met. By combining the lessons learnt from the past with the teams' current league position, the program calculates a draw probability factor for each match. It then uses these factors to identify the matches most likely to produce draws and outputs a suitable prediction.

It is up to you to take the program's predictions and combine them into a suitable perm for your pools coupon. Later in this article I will make some suggestions for filling in your coupon, but a lot depends on how much you are prepared to spend each week. Not surprisingly, the more that you spend on the pools, the more likely you are to win something.

The article has four main sections. It describes the program's menu approach, how its functions are coded and used, and how to use the program itself. Finally, there are some hints and tips on getting the most out of it.

The Menu

The program is written on a modular basis to make it easier to write, debug and understand; this approach lends itself well to incorporating a menu. When the program is RUN, it first loads its data base and then offers the main menu (Fig. 1), from which its seven principal functions can be selected. Some of the individual functions also have their own menus.

Once a function has done its job, the program always returns to the main menu, from which any function can again be selected.

Operating Note Several of the program functions use a dialogue between the computer and the operator. For instance, menu selections are made via the numeric keys, you must answer the computer's questions, and you must specify matches.

```
                    OPTIONS

SET UP LEAGUE POSITION RECORDS   1
SET UP TEAM PERFORMANCE RECORDS  2
INPUT MOST RECENT RESULTS        3
CREATE MATCH LIST                4
PREDICT NEXT WEEK'S DRAWS        5
SAVE DATA BASE TO CASSETTE       6

CREATE DATA BASE                 7

FINISH                           9

SELECT OPTION
```

Fig. 1. The main option menu

Most of these choices can be made by single keystrokes. Every time a single keystroke is expected, the program responds directly to the relevant key. There is no need to press ENTER (VG owners read as NEWLINE), and the system will ignore any garbage, such as pressing '8' when the main menu is on display.

Occasionally the computer will ask questions such as 'VERIFY?'. Answer these with 'Y' for Yes and 'N' for No. Again, there is no need to press ENTER.

Sometimes, however, the program cannot predict how many keys will be pressed. For instance, when setting up a list of matches, you can enter a positive integer of any length. In such cases, you should use ENTER in the usual way.

The program does *not* cover the Scottish Second Division. There are two reasons for this:

a. The division's matches do not often appear on the pools coupon.

b. Its results follow a law only to themselves — the program is completely baffled!

Program Functions

Let's get down to the brass tacks now. Listing 1 is the program in all its glory, and Table 1 defines the main variables. When you study the listing you will see that the heart of the program is a loop at lines 500-540 that controls everything else.

The first time into the loop, the initialisation routine at line 1000 sets up all the program constants, such as the team names, and reads in and verifies the data base. That done, control returns to the main segment, which immediately calls the main menu subroutine at line 2000.

This routine displays the options, and waits for a selection to be made. When a valid key is pressed, the routine hands back control to the core segment; this uses the input value to select one of the seven subroutines which control the program's major functions. Once the subroutine has done its job, line 540 takes us back to line 510, and the main menu, again.

	Arrays
FL(5,23)	Form and League position of teams
LN$(5)	Division names
LT$(5,23)	Team names
MT(5,11,1)	Match list and computed draw prob
NT(5)	Number of teams in each division
PD(35,35)	Record of previous matches
Q!(4)	Relative league position weighting
	Other Variables
I,J,K	General purpose loop counters
X,X$	General purpose inputs
FZ	'Create Data Base' flag
KW!	Exponential weighting rate factor
A,B,C,C1	Used in ordering draws
FX,FY,FH,FA	Used in form calculations
LB	Relative league position
M1,M2,MX	Used in packing team numbers
P,P1,P2,	Used in probability calculations
P3!,P4!	"
Q1$,Q2$,	Used as cassette I/O strings
Q5$,Q6$	"
TM,T1,T2	Team numbers
T8,T9	Position of team on display
XX,YY$	Used in keyboard read routine

Table 1. Arrays and variables used in the program

Last month's article explained the purpose of the seven functions; let's now see how each one is used.

Set Up League Position Records (lines 3000-3100). The program must know where in a division a team is placed, and splits each division into three sections: top quarter, middle and bottom quarter. The precise split is not critical, but these proportions give good results. Teams in the top have a rating of '1', those in the middle a rating of '2', while the stragglers rate as '3'.

Select the function by pressing '1' from the main menu. You are then offered the first (alphabetically) team in the First Division. Press the appropriate key to define its rating and you see the next team, and so on.

At the end of each division, you can either go on to the next or return to the main menu. At the end of the Scottish First Division, the program automatically takes you back to the menu.

The program stores data about team performance in the integer array FL(5,23). To save space, each location in the array holds two items of data about its relevant team — its league position is in the high byte, while its current form goes into the low byte. The coding in line 3050 takes care of getting the league position into the high byte without disturbing anything else.

Insert Team Performances (lines 4000-4150). To work properly, the program must know each team's recent form. Once you are using the program every week it maintains its own form record, but at the beginning of the season you must put starting values into the data base.

As I explained last month, a team's form depends on its last two results. Each match could have been at home or away, and in each one the team could have won, drawn or lost. There are thus six possibilities: HW, HD, HL, AW, AD or AL. The six are assigned 0-5 points respectively.

To define a team's form, multiply its points for the match before last by six, and add the points for the last match. For example, a HK, AL recorded is coded as 11, and 29 means AD, AL.

When you enter this function by pressing '2' from the main menu, you see a subsidiary menu (via lines 4500-4580) which allows you to select a division. Do so, and you see a list of the teams in the division. To define a team's form, enter the team number and, when the program prompts you, input its form code. Teams whose form has been input are identified by a '*' next to them; this does not prevent your re-entering their form.

As in the previous function, the data is POKEd into the relevant byte of the form array. Line 4140 does the job.

Entering '50' for a team recalls the division selection menu, while 100 or more ends the procedure. The function does not alter the form of any team that is not specifically selected.

Input the Latest Results (lines 5000-5150). Every week, you must enter the results of that week's matches. The program uses this data to adjust its record of teams' form and to update the main prediction data base.

Select route '3' from the main menu. You are then offered the first match, and can input the result, coded as Home Win ('1'), Away Win ('2'), or Draw ('X'). If the match was postponed, press 'P'. The program will then offer you the next match, and so on, until all the results have gone in.

Each match is coded as a location on level 0 of MT(5,11,1). The two teams are stored as ((home team number *100) + away team number); line 5050 separates them. Lines 5100 and 5130 have the job of updating the teams' form, while 5120 alters the main probability matrix.

The vagaries of Level II BASIC mean that, for the first match only, there is a short delay between pressing the result key and being offered the next match.

Create Match List (lines 6000-6210). Obviously, before the program can predict anything, it has to know what matches are going to be played. You tell it by pressing '4' when the main menu is displayed.

The display will change to show the First Division and a prompt to enter two teams. Once you have defined a match, the teams are deleted from the display and the program asks for two more.

If you should enter as either team a number greater than 99, the program will display the next division. The next division is automatically offered when you have assigned all the teams in the existing division to matches. At the end of the Scottish First Division the main menu reappears.

In a similar way to the previous function, there is a delay between defining the very first match and the teams' disappearance from the screen.

Note that you can only define matches which occur betwen teams in a single division. The program is thus only of limited value for predicting the results of Cup ties (which are often very odd anyway).

Predict Next Week's Draws (lines 7000-7370). Here, at last, is the whole reason for the program. Press '5' from the main menu and the program starts to assess the chances of each match's being a draw.

The program goes through each match, identifying the teams and extracting their form. Using the form, it then extracts the crude probability of a draw from the probability matrix PD(35,35) which contains the record of all previous draws. The crude value is scaled and weighted as we discussed last month (lines 7070-7090 do the work) and then saved in level 1 of MT(5,11,1). To get around the difficulty of saving a floating point probability value in an integer array, the program actually saves 10,000 times the true value.

As it computes the probabilities for each division, the computer displays its progress on the monitor and, when it has finished, it lists the 14 'most likely' draws.

Each line of the output is produced by the subroutine at line 7500 and shows the match, its computed draw probability and the number of matches on which the prediction is based. The latter value is shown in the right-hand column of the output and gives you an idea of the confidence of the prediction — the more matches there are the better.

The program in the listing outputs 14 'likely' draws. You can easily change this number by adjusting the upper limit of the FOR...NEXT loop which starts in line 7130.

Once the draws have been listed, the program waits while you write them down. When you are ready, press any key to tell the program to list the eight 'least likely' draws; to change this value, alter line 7250. Once the 'least likely' draws have been listed, the program again waits — press any key to go back to the main menu.

Save the Data to Cassette (lines 8000-8120). You must save the data base from week to week, and this function makes it possible.

When you select it, the program prompts you to set your cassette recorder to RECORD. Do so, press any key, and leave the computer to its own resources for about eight minutes!

That's how long it takes to save PD(35,35), FL(5,23) and MT(5,11,1). The data is saved as 42(0-41) separate segments, and the progress is displayed on the monitor as a countdown.

Once the data has been recorded, the program gives you the chance to verify that it has been saved correctly. This is vital, because any tape corruption would irretrievably ruin the data base. Rewind the tape, select PLAY, press any key, and the routine at lines 8200-8480 reads in all 42 segments and compares them with the original data.

If it is OK, then the program goes

back to the main menu otherwise an error message is displayed. In the latter case it would be wise to repeat the verification — if it fails again, decline the offer of yet another verify and re-record the data.

The save and verify routines use the subroutines at lines 8800-8970 to pack the numeric data from the arrays into long strings suitable for the PRINT#-1 and INPUT#-1 statements. The data input routine at lines 8500-8670 spends much of its time unpacking these strings and putting the data back into the arrays.

Create the Data Base (lines 10000-10030). It has to be possible to use the program to create the data base from scratch. This is, unfortunately, a very tedious exercise which demands the inputting of at least a season's worth of matches and their results before the program is usable. You could use options 3 and 4 to do the job, but option 7 makes the exercise slightly less formidable.

It behaves very much like option 4 (Create Match List), but, every time that a match is defined, the program immediately calls for its result on the same 1,2,X scale as the 'Input Latest Results' function.

The routine is entered via a call to line 10000, but all the subroutine there does is set flag FZ and call the normal option 4 routine at line 6000. That routine looks at FZ — if it is not set it enters the match into MT(5,11,1) but, if FZ *is* set, then the subroutine at line 6500 is called. This takes the result and updates the various parts of the data base in the usual way.

Using The Program

Having said all that, how do we actually use the program?

Start the Program The program's first action is to call for the data base. Load the tape into the cassette drive, select PLAY, and press any key on the keyboard. The program will then read in the 42 data segments, giving a countdown of its progress.

Once the data has been loaded, the program will offer you the chance to verify the load; I strongly recommend that you do this every time. If a failure should occur, the best action is to re-RUN the program from the start. If the verify is OK, or you decline it, the program goes straight to the main menu.

Update the Results Normally, you would expect to run the program some time between 5 pm on a Saturday and Tuesday evening. The first step is to update the main data base by inputting the results from the games played on Saturday. Normally you will be able to use the match list, already in RAM, that was saved on tape from last time. Occasionally, though, you will have to re-enter the match list using the matches that *were* played.

At this point you should also consider updating the league position tables.

Predict Next Week's Results Once the data base has been updated, input next week's match list, and run the draw prediction function to give you a list of the 'likely' and 'unlikely' draws.

Shut Down the Program Save the data base as described above.

Midweek Matches It is important to save the results of midweek matches since they will affect the records of draw probability and team form. You should use option 7 (Create the Data Base) at some suitable time *before* you put in the main Saturday results.

Entering the midweek results will not affect the match list but be warned that, since it alters the data base, the draw predictions could well change.

Start of the Season At the start of the season you must make sure that the program has the correct record of which teams are in which divisions. The data is held in lines 1500-1560 which, in Listing 1, contain the 1981/82 League tables.

There is little point in using the program at the very start of the season, since it takes the teams about a month to settle down. After that time, you should input the initial 'recent form', using option 2, and the teams' league positions. You can then have a go at predicting your first matches.

Once you are using the program every week it automatically keeps the team form up to date, but you must decide when to alter the league position tables. In general, they are not worth altering if only a few clubs have moved to a different band.

Hardcopy If you have a printer, then you will want to list the predictions rather than copy them down from the monitor screen. To get a suitable printout, make the following alterations to the program:

a. 7120 CLS:LPRINT "MOST LIKELY DRAWS":LPRINT

b. 7250 LPRINT:LPRINT:LPRINT "LEAST LIKELY DRAWS":LPRINT

c. Change all the PRINTs in lines 7530 and 7540 to LPRINTS.

d. Delete lines 7220, 7230, 7350 and 7360.

Hints And Tips

How you set up your perm is up to you but you might, for example, like to try several '8-from12's, In each 12, 11 of the matches should be taken from the 'likely' list, and the last one from the 'unlikely'. Obviously, you should choose a different combination of 12 for each row.

I must emphasise that there is no 'best' way of using the data. It goes without saying, I hope, that the more money you or your syndicate are prepared to invest, then the more lines you will have on the coupon and the better your chances of winning.

Fiddle Factors The program contains several important weighting factors, the roles of which were explained in detail last month. I chose them after considerable experiment but, if you wish to experiment further, you can alter them easily. They are all defined by line 1060.

a. **Q!(0-4)** Array Q!(4) controls the effect of the teams' relative league position on the prediction. The program computes the relative position by subtracting the away team's position code from that of the home team, giving possible values of -2,-1,0,1,2. These correspond to Q!(0) to Q!(4) respectively. Increase the values to increase the *predicted* draw possibility.

b. **KW!** The program mixes the data base prediction of draw probability with the overall chance of any matches being a draw. KW! is the exponential weighting ratio of the 2 probabilities; increase it to emphasise the effect of the overall average (25% chance of a draw) at the expense of the specific form-based prediction.

Creating the Data Base I have explained that you must use option 7 to input the results of at least a season's worth of matches before the program is remotely usable. This is a mammoth exercise — it is unlikely to take you less than 60-80 hours of painstaking effort — but it must be done. There is one small problem though.

Whenever you run the program, it insists on loading the data tape. The very first time that you use it, you won't have a data tape. What do you do?

The answer is easy. Load the program and, before you RUN it, add an extra line:

```
1095 RETURN
```

This will make the program skip the tape-loading routines and go straight into the main menu. Start creating the data base, save it, and then, when you next RUN the program, you will have a data tape for it to work on.

Data Backup What would happen if, say, the tape with your data base on was shredded by the dog? You would have to recreate it from scratch, that's what. It is therefore a wise precaution to take a backup copy of the data base at regular intervals — say monthly.

Conclusions

In this article I've explained the key points of a program which can help you to win the pools. I've described how to use each part of it, and the normal way in which you would use it every week.

(If any reader wishes to make further enquiries about this program the author can be contacted through CT. Mark your enquiries POOLS PREDICTION and they will be forwarded. Ed.)

Program Listing

```
  1Ø  REM**POOLS PREDICTION PROGRAM
  3Ø  CLEAR 14ØØ:DEFINT A-Z
  4Ø  DIM FL(5,23),LN$(5),LT$(5,23),MT(5,11,1 ),
      NT(5),PD(35,35),Q!(4)
  5Ø  CLS:PRINT CHR$(23):PRINT@335,"COMPUTE A DRAW";:
      PRINT@643,"ORIGINATED BY DAVE PECKETT"
 499  REM**MAIN CONTROLLING SEGMENT
 5ØØ  GOSUB 1ØØØ:REM**INITIALISE
 51Ø  GOSUB 2ØØØ:REM**DISPLAY OPTIONS
 52Ø  IF OP=9 THEN CLS:END
 53Ø  ON OP GOSUB 3ØØØ,4ØØØ,5ØØØ,6ØØØ,7ØØØ,8ØØØ,1ØØØØ
 54Ø  GOTO 51Ø
 999  REM**INITIALISATION SUBROUTINE
1ØØØ  FOR I=Ø TO 5
1Ø1Ø  READ NT(I):REM**NUMBER OF TEAMS
1Ø2Ø  FOR J=Ø TO NT(I)-1
1Ø3Ø  READ LT$(I,J):REM**READ DIVISIONS
1Ø4Ø  NEXT J,I
1Ø5Ø  REM**THE VALUES SET IN THE NEXT LINE CONTROL THE
      PROGRAM'S SENSITIVITY TO LEAGUE POSITION ETC. CHANGE
      THEM TO EXPERIMENT (SEE INSTRUCTIONS!)
1Ø6Ø  Q!(Ø)=Ø.4:Q!(1)=Ø.7:Q!(2)=1:Q!(3)=1.3:Q!(4)=1.1:KW!=
      15:FZ=Ø
1Ø7Ø  FOR I=Ø TO 5
1Ø8Ø  READ LN$(I):LN$(I)=LN$(I)+"[SPC]DIVISION":
      REM**DIVISION NAMES
1Ø9Ø  NEXT I
11ØØ  CLS:PRINT "PREPARE TO LOAD DATA - PRESS ANY KEY WHEN
      READY"
111Ø  IF INKEY$="" THEN 111Ø
112Ø  GOSUB 85ØØ:REM**READ DATA TAPE
113Ø  GOSUB 82ØØ:REM**VERIFY
114Ø  RETURN
15ØØ  REM**DATA FOR TEAM LISTS
15Ø5  REM**FIRST DIVISION
151Ø  DATA 22,ARSENAL,ASTON VILLA,B'HAM
      CITY,BRIGHTON,COVENTRY,EVERTON,IPSWICH,LEEDS,
      LIVERPOOL,MAN. CITY,MAN. UTD.,M'BOROUGH,
      NOTTS CTY.,NOTTS FOR.,SOUTHAMPTON,STOKE,
      SUNDERLAND,SWANSEA,TOTTENHAM H.,WBA,WEST HAM,WOLVES
1515  REM**SECOND DIVISION
152Ø  DATA 22,BARNSLEY,BLACKBURN,BOLTON,CAMBRIDGE,CARDIFF,
      CHARLTON,CHELSEA,C. PALACE,DERBY,GRIMSBY,LEICESTER,
      LUTON,NEWCASTLE,NORWICH,OLDHAM,ORIENT,QPR,ROTHERHAM,
      SHEFFIELD WED.,SHREWSBURY,WATFORD,WREXHAM
1525  REM**THIRD DIVISION
153Ø  DATA 24,BRENTFORD,BRISTOL CITY,BRISTOL ROV.,BURNLEY,
      CARLISLE,,CHESTER,CHESTERFIELD,DONCASTER,EXETER,
      FULHAM,GILLINGHAM,HUDDERSFIELD,LINCOLN,MILLWALL,
      NEWPORT,OXFORD,PLYMOUTH,PORTSMOUTH,PRESTON,
      READING,SOUTHEND,WALSALL,WIMBLEDON
1535  REM**FOURTH DIVISION
154Ø  DATA 24,ALDERSHOT,BLACKPOOL,BOURNEMOUTH,BRADFORD,
      BURY,COLCHESTER,CREWE,DARLINGTON,HALIFAX,HARTLEPOOL,
      HEREFORD,HULL,MANSFIELD,NORTHAMPTON,PETERBOROUGH,
      PORT VALE,ROCHDALE,SCUNTHORPE,SHEFFIELD UTD.,
      STOCKPORT,TORQUAY,TRANMERE,WIGAN,YORK
1545  REM**SCOTTISH PREMIER DIVISION
155Ø  DATA 1Ø,ABERDEEN,AIRDRIE,CELTIC,DUNDEE,DUNDEE
      UTD.,HIBS,MORTON,PARTICK,RANGERS,ST MIRREN
1555  REM**SCOTTISH FIRST DIVISION
156Ø  DATA 14,AYR,CLYDEBANK,DUMBARTON,DUNFERMLINE,
      E. STIRLING,FALKIRK,HAMILTON,HEARTS,KILMARNOCK,
      MOTHERWELL,Q OF S,QUEEN'S PARK,RAITH ROVERS,
      ST JOHNSTONE
1565  REM**DIVISION NAMES
157Ø  DATA FIRST,SECOND,THIRD,FOURTH,SCOTTISH
      PREMIER,SCOTTISH FIRST
1999  REM**SELECT OPTION
2ØØØ  CLS:PRINT@23," OPTIONS":PRINT
2Ø1Ø  PRINT TAB(1Ø)"SET UP LEAGUE POSITION
      RECORDS"TAB(45)1
2Ø2Ø  PRINT TAB(1Ø)"SET UP TEAM PERFORMANCE
      RECORDS"TAB(45)2
2Ø3Ø  PRINT TAB(1Ø)"INPUT MOST RECENT RESULTS"TAB(45)3
2Ø4Ø  PRINT TAB(1Ø)"CREATE MATCH LIST"TAB(45)4
2Ø5Ø  PRINT TAB(1Ø)"PREDICT NEXT WEEK'S DRAWS"TAB(45)5
2Ø6Ø  PRINT TAB(1Ø)"SAVE DATA BASE TO CASSETTE"TAB(45)6
2Ø7Ø  PRINT:PRINT TAB(1Ø)"CREATE THE DATA BASE"TAB(45)7
2Ø8Ø  PRINT:PRINT:PRINT TAB(1Ø)"FINISH"TAB(45)9
2Ø9Ø  PRINT@96Ø,"SELECT OPTION";
21ØØ  OP$=INKEY$:IF OP$<"1" OR OP$="8" OR OP$>"9" THEN
      21ØØ
211Ø  OP=VAL(OP$)
212Ø  RETURN
2999  REM**SET UP LEAGUE POSITION RECORDS
3ØØØ  I=Ø
3Ø1Ø  CLS:PRINT LN$(I);"[3 SPC]POSITIONS - 1, 2 OR 3":
      PRINT
3Ø2Ø  FOR J=Ø TO NT(I)-1
3Ø3Ø  PRINT LT$(I,J) TAB(2Ø)"?";
3Ø4Ø  X$=INKEY$:IF X$<"1" OR X$>"3" THEN 3Ø4Ø
3Ø5Ø  POKE(VARPTR(FL(I,J))+1),VAL(X$):PRINT CHR$(24);X$:
      REM**SAVE AS HIGH BYTE OF FL
3Ø6Ø  NEXT J
3Ø7Ø  IF I=6 THEN RETURN
3Ø8Ø  PRINT:PRINT:PRINT TAB(1Ø)"NEXT DIVISION?";
3Ø9Ø  X$=INKEY$:IF X$<>"Y" AND X$<>"N" THEN 3Ø9Ø
31ØØ  IF X$="N" THEN RETURN ELSE I=I+1:GOTO 3Ø1Ø
3999  REM**SET UP TEAM PERFORMANCE RECORD
4ØØØ  GOSUB 45ØØ:REM**SELECT DIVISION
4Ø1Ø  GOSUB 9ØØØ:REM**DISPLAY DIVISION
4Ø2Ø  PRINT@832,"HW=Ø HD=1 HL=2 AW=3 AD=4 AL=5. RECORD=
      L-2*6+L-1
4Ø3Ø  PRINT@896,"TEAM>99 TO FINISH. TEAM=5Ø FOR NEW
      DIVN.";
4Ø4Ø  PRINT@96Ø,"TEAM?[5 SPC]";:PRINT@967,"";:GOSUB 95ØØ
4Ø5Ø  TM=XX
4Ø6Ø  IF TM>99 THEN RETURN
4Ø7Ø  IF TM=5Ø THEN 4ØØØ
4Ø8Ø  IF TM>=NT(X) THEN 4Ø4Ø
4Ø9Ø  PRINT@97Ø,"RECORD?[5 SPC]";:PRINT@978,"";:GOSUB 95ØØ
41ØØ  RC=XX
411Ø  IF RC>35 THEN 4Ø9Ø
412Ø  IF TM>=I9 THEN T8=(TM-I9)*64+15456 ELSE
      T8=TM*64+15424
413Ø  POKE(T8),42:REM**MARK TEAM
414Ø  POKE(VARPTR(FL(X,TM))),RC:REM**SAVE AS LOW BYTE OF
      FL
415Ø  PRINT@96Ø,STRING$(3Ø,"[SPC]");:GOTO 4Ø4Ø
4499  REM**SELECT A DIVISION
45ØØ  CLS:PRINT@24,"SELECT DIVISION":PRINT
451Ø  FOR I=Ø TO 5
452Ø  PRINT TAB(13) LN$(I) TAB(49) I+1
453Ø  NEXT I
454Ø  PRINT:PRINT:PRINT
455Ø  PRINT TAB(22)"WHICH DIVISION";
456Ø  X$=INKEY$:IF X$<"1" OR X$>"6" THEN 456Ø
457Ø  X=VAL(X$)-1
458Ø  RETURN
4999  REM**LATEST RESULTS
5ØØØ  FOR I=Ø TO 5
5Ø1Ø  CLS:PRINT@1Ø,"UPDATE DATA FOR[SPC]";LN$(I)
5Ø2Ø  FOR J=Ø TO 11
5Ø3Ø  PRINT@128,CHR$(3Ø);
5Ø4Ø  IF MT(I,J,Ø)=Ø THEN 513Ø:REM**NO MORE IN DIVN
5Ø5Ø  MX=MT(I,J,Ø):M1=MX/1ØØ:M2=MX-M1*1ØØ
5Ø6Ø  PRINT@128,LT$(I,M1);" VS ";LT$(I,M2);
5Ø7Ø  PRINT@256,"RESULT? (1, 2 X OR P(OSTPONED))";
5Ø8Ø  X$=INKEY$:IF X$<>"1" AND X$<>"2" AND X$<>"X"
      AND X$<>"P" THEN 5Ø8Ø
5Ø9Ø  IF X$="P" THEN 514Ø ELSE IF X$="1" THEN RT=Ø ELSE IF
      X$="2" THEN RT=2 ELSE RT=1
51ØØ  FH=PEEK(VARPTR(FL(I,M1))):FA=PEEK(VARPTR(FL(I,M2))):
      REM**EXTRACT CURRENT FORM
511Ø  Q=PD(FH,FA):IF Q-INT(Q/256)*256=255 THEN
      513Ø:REM**DATA BASE CELL FULL?
512Ø  IF RT=1 THEN PD(FH,FA)=Q+257 ELSE
      PD(FH,FA)=Q+1:REM**UPDATE PROB'Y
513Ø  FX=FH/6:POKE(VARPTR(FL(I,M1))),(FH-FX*6)*6+RT:
      FY=FA/6:POKE(VARPTR(FL(I,M2))),(FA-FY*6)*6+5-RT:
      REM**UPDATE FORM
514Ø  NEXT J:NEXT I
515Ø  RETURN
5999  REM**CREATE MATCH LIST
6ØØØ  CLS:IF FZ THEN 6Ø4Ø ELSE PRINT "ZEROING MATCH ARRAY"
6Ø1Ø  FOR I=5 TO Ø STEP-1:PRINT I;:FOR J=Ø TO 11:
      MT(I,J,Ø)=Ø:NEXT J:NEXT I:PRINT
6Ø2Ø  CLS
6Ø3Ø  REM**START THRU DIV'NS
6Ø4Ø  FOR X=Ø TO 5
6Ø5Ø  I=Ø
6Ø6Ø  GOSUB 9ØØØ:REM**PRINT DIV'N
6Ø7Ø  PRINT@832,"ENTER HOME, AWAY TEAMS. EITHER>99
      FOR NEXT DIV."
6Ø8Ø  PRINT@9ØØ,CHR$(3Ø);:PRINT@9ØØ,"HOME?[6 SPC]";:
      PRINT@9Ø6,"";:GOSUB 95ØØ
```

```
6090  T1=XX:IF T1>99 THEN 619Ø
61ØØ  PRINT@912,"AWAY?[6 SPC]";:PRINT@918,"";:
      GOSUB 95ØØ
611Ø  T2=XX:IF T2>99 THEN 619Ø
612Ø  IF T1=T2 OR T1>NT(X) OR T2>NT(X) THEN 6Ø8Ø:
      REM**TEAM OK?
613Ø  IF T1>=I9 THEN T8=(T1-I9)*64+97 ELSE T8=T1*64+65:
      REM**POS'N OF TEAM..
614Ø  IF T2>=I9 THEN T9=(T2-I9)*64+97 ELSE T9=T2*64+65:
      REM**..ON SCREEN
615Ø  IF PEEK(1536Ø+T8)=32 OR PEEK(1536Ø+T9)=32 THEN
      6Ø8Ø:REM**TEAMS DELETED?
616Ø  IF FZ THEN GOSUB 65ØØ ELSE MT(X,I,Ø)=T1*1ØØ+T2:
      REM**MATCH CODE
617Ø  PRINT@T8,STRING$(25,"[SPC]");:PRINT@T9,STRING$(25,
      "[SPC]");:REM**DELETE TEAMS
618Ø  I=I+1:IF I<NT(X)/2 THEN 6Ø8Ø
619Ø  NEXT X:REM**NEXT DIV'N
62ØØ  RETURN
6499  REM**SUBROUTINE USED FOR CREATING DATA BASE
65ØØ  PRINT@924,"RESULT (1, 2 OR X)";
651Ø  X$=INKEY$:IF X$<>"1" AND X$<>"2" AND X$<>"X"
      THEN 651Ø
652Ø  IF X$="1" THEN RT=Ø ELSE IF X$="2" THEN RT=2
      ELSE RT=1
653Ø  FH=PEEK(VARPTR(FL(X,T1))):FA=PEEK(VARPTR(FL(
      X,T2))):REM**EXTRACT CURRENT FORM
654Ø  Q=PD(FH,FA):IF Q-INT(Q/256)*256=255 THEN 656Ø:
      REM**DB CELL FULL?
655Ø  IF RT=1 THEN PD(FH,FA)=Q+257 ELSE PD(FH,FA)=Q+1:
      REM**UPDATE PROB'Y
656Ø  FX=FH/6:POKE(VARPTR(FL(X,T1))),(FH-FX*6)*6+RT:
      FY=FA/6:POKE(VARPTR(FL(X,T2))),(FA-FY*6)*6+5-RT:
      REM**UPDATE FORM
657Ø  RETURN
6999  REM**PREDICT RESULTS
7ØØØ  CLS:PRINT "PREDICTING RESULTS":PRINT
7Ø1Ø  FOR I=Ø TO 5
7Ø2Ø  PRINT LN$(I):REM**DIVISION
7Ø3Ø  FOR J=Ø TO 11
7Ø4Ø  MX=MT(I,J,Ø):IF MX=Ø THEN 71ØØ:REM**FINISHED DIV'N?
7Ø5Ø  T1=MX/1ØØ:T2=MX-T1*1ØØ:REM**TEAMS
7Ø6Ø  FH=PEEK(VARPTR(FL(I,T1))):
      FA=PEEK(VARPTR(FL(I,T2))):REM**EXTRACT FORM
7Ø7Ø  P=PD(FH,FA):P1=P/256:P2=P-P1*256:IF P=Ø THEN P=2ØØØ
      ELSE P3!=EXP(-P2/KW!)/2:P4!=1-P3!:P=(P4!*P1/P2+P3!/
      4)*1ØØØØ:REM**RAW PROB.
7Ø8Ø  LB=INT(FL(I,T1)/256)-INT(FL(I,T2)/256):
      REM**RELATIVE LEAGUE POSITION
7Ø9Ø  MT(I,J,1)=P*Q!(LB+2):REM**FINAL PROB'Y
71ØØ  NEXT J,I
711Ø  REM**OUTPUT THE 'LIKELY' DRAWS
712Ø  CLS:PRINT "MOST LIKELY DRAWS:"
713Ø  FOR I=1 TO 14:REM**CHANGE THIS FOR MORE OR FEWER
      LIKELY DRAWS
714Ø  A=Ø:B=Ø:C=Ø
715Ø  FOR J=Ø TO 5
716Ø  FOR K=Ø TO 11
717Ø  C1=MT(J,K,1)
718Ø  IF C1>C AND C1>=Ø AND MT(J,K,Ø)<>Ø THEN
      C=C1:A=J:B=K:REM**FIND AND MARK THE HIGHEST PROB'Y
719Ø  NEXT K,J
72ØØ  GOSUB 75ØØ:REM**PRINT DATA
721Ø  NEXT I
722Ø  PRINT "ANY KEY TO CONTINUE";
723Ø  IF INKEY$="" THEN 723Ø
724Ø  REM**PRINT THE 'UNLIKELY' DRAWS
725Ø  CLS:PRINT "LEAST LIKELY DRAWS:"
726Ø  FOR I=1 TO 8:REM**CHANGE THIS FOR MORE OR FEWER
      UNLIKELY DRAWS
727Ø  A=Ø:B=Ø:C=1ØØØØ
728Ø  FOR J=Ø TO 5
729Ø  FOR K=Ø TO 11
73ØØ  C1=MT(J,K,1)
731Ø  IF C1<C AND C1>=Ø AND MT(J,K,Ø)<>Ø THEN
      C=C1:A=J:B=K:REM**FIND AND MARK LOWEST PROB'Y
732Ø  NEXT K,J
733Ø  GOSUB 75ØØ:REM**PRINT DATA
734Ø  NEXT I
735Ø  PRINT:PRINT "ANY KEY TO CONTINUE"
736Ø  IF INKEY$="" THEN 736Ø
737Ø  RETURN
7499  REM**PREPARE AND DISPLAY A LINE OF OUTPUT
75ØØ  MX=MT(A,B,Ø):T1=MX/1ØØ:T2=MX-T1*1ØØ:REM**GET TEAMS
751Ø  FH=PEEK(VARPTR(FL(A,T1))):FA=PEEK(VARPTR(FL(A,T2))):
      REM**TEAMS' FORM
752Ø  Z9=PD(FH,FA):NM=Z9-INT(Z9/256)*256:REM**SAMPLE SIZE
753Ø  PRINT STR$(I);"." TAB(7) LT$(A,T1) TAB(25) "VS[SPC]"
      LT$(A,T2) TAB(5Ø);:REM**PRINT MATCH
754Ø  PRINT USING "#.####";C/1ØØØØ;:PRINT TAB(59) NM:
      REM**PROB.
755Ø  MT(A,B,1)=-C:REM**CLEAR FROM RECORD
756Ø  RETURN
7999  REM**SAVE DATA BASE TO CASSETTE
8ØØØ  CLS:PRINT "SET UP TAPE - PRESS ANY KEY WHEN READY"
8Ø1Ø  IF INKEY$="" THEN 8Ø1Ø
8Ø2Ø  CLS:PRINT@2Ø,"SAVING DATA":PRINT
8Ø3Ø  FOR I=Ø TO 35:REM**SAVE PD()
8Ø4Ø  PRINT 41-I,
8Ø5Ø  GOSUB 88ØØ:REM**FORMAT PD()
8Ø6Ø  PRINT#-1,Q1$
8Ø7Ø  NEXT I
8Ø8Ø  FOR I=Ø TO 5:REM**SAVE FL AND MT
8Ø9Ø  PRINT 5-I,
81ØØ  GOSUB 89ØØ:REM**FORMAT FL AND MT
811Ø  PRINT#-1,Q1$:PRINT#-1,Q2$
812Ø  NEXT I
8199  REM**VERIFY A CASSETTE TAPE
82ØØ  PRINT:PRINT
821Ø  PRINT "VERIFY?";
822Ø  X$=INKEY$:IF X$<>"Y"AND X$<>"N" THEN 822Ø
823Ø  IF X$="N" THEN RETURN
824Ø  CLS:PRINT "REWIND TAPE - PRESS ANY KEY WHEN READY"
825Ø  IF INKEY$="" THEN 825Ø
826Ø  CLS:PRINT@19,"VERIFYING DATA":PRINT
827Ø  I=Ø:REM**VERIFY PD()
828Ø  PRINT 41-I,
829Ø  GOSUB 88ØØ:REM**FORMAT PD()
83ØØ  INPUT#-1,Q5$
831Ø  IF Q1$<>Q5$ THEN 845Ø:REM**DATA OK?
832Ø  I=I+1:IF I<36 THEN 828Ø:REM**FINISHED PD()?
833Ø  I=Ø:REM**VERIFY FL AND MT
834Ø  PRINT 5-I,
835Ø  GOSUB 89ØØ:REM**FORMAT FL AND MT
836Ø  INPUT#-1,Q5$:INPUT#-1,Q6$
837Ø  IF Q1$<>Q5$ OR Q2$<>Q6$ THEN 845Ø:REM**DATA OK?
838Ø  I=I+1:IF I<6 THEN 834Ø:REM**FINISHED FL AND MT?
839Ø  PRINT:PRINT "VERIFY GOOD - PRESS ANY KEY TO CONTINUE"
84ØØ  IF INKEY$="" THEN 84ØØ
841Ø  RETURN
845Ø  PRINT:PRINT "VERIFY FAILED - REPEAT?"
846Ø  X$=INKEY$:IF X$<>"Y" AND X$<>"N" THEN 846Ø
847Ø  IF X$="N" THEN RETURN ELSE GOTO 824Ø
8499  REM**LOAD DATA BASE FROM CASSETTE
85ØØ  CLS:PRINT@2Ø,"READING DATA":PRINT
851Ø  FOR I=Ø TO 35:REM**READ PD()
852Ø  PRINT 41-I,
853Ø  INPUT#-1,Q1$
854Ø  FOR J=Ø TO 35
855Ø  PD(I,J)=VAL(MID$(Q1$,5*J+1,5)):REM**STORE A ROW
856Ø  NEXT J,I
857Ø  FOR I=Ø TO 5:REM**READ FL AND MT
858Ø  PRINT 5-I,
859Ø  INPUT#-1,Q1$:INPUT#-1,Q2$
86ØØ  FOR J=Ø TO 11
861Ø  J8=J*1Ø+1:J9=J8+5
862Ø  FL(I,J)=VAL(MID$(Q1$,J8,5))
863Ø  FL(I,J+12)=VAL(MID$(Q1$,J9,5))
864Ø  MT(I,J,Ø)=VAL(MID$(Q2$,J8,5))
865Ø  MT(I,J,1)=VAL(MID$(Q2$,J9,5))
866Ø  NEXT J,I
867Ø  RETURN
8799  REM**PREPARE A COLUMN OF PD()
88ØØ  Q1$="":REM**NULL STRING
881Ø  FOR J=Ø TO 35
882Ø  Q3$=STR$(PD(I,J))
883Ø  Q1$=Q1$+RIGHT$("ØØØØØ"+RIGHT$(Q3$,LEN(Q3$)-1),5)
884Ø  NEXT J
885Ø  RETURN
3899  REM**PREPARE A ROW OF FL() AND MT()
89ØØ  Q1$="":Q2$="":REM**NULL STRINGS
891Ø  FOR J=Ø TO 11
892Ø  Q3$=STR$(FL(I,J)):Q4$=STR$(FL(I,J+12))
893Ø  Q1$=Q1$+RIGHT$("ØØØØØ"+RIGHT$(Q3$,LEN(Q3$)-1),5)+
      RIGHT$("ØØØØØ"+RIGHT$(Q4$,LEN(Q4$)-1),5)
894Ø  Q3$=STR$(MT(I,J,Ø)):Q4$=STR$(MT(I,J,1))
895Ø  Q2$=Q2$+RIGHT$("ØØØØØ"+RIGHT$(Q3$,LEN(Q3$)-1),5)+
      RIGHT$("ØØØØØ"+RIGHT$(Q4$,LEN(Q4$)-1),5)
896Ø  NEXT J
897Ø  RETURN
8999  REM**DISPLAY A DIVISION
9ØØØ  CLS:PRINT@(26-LEN(LN$(X))/2),LN$(X)
9Ø1Ø  I9=NT(X)/2
9Ø2Ø  FOR I8=1 TO I9
9Ø3Ø  PRINT I8-1;TAB(4)LT$(X,I8-1);TAB(32)I8+I9-1;
      TAB(36)LT$(X,I8+I9-1)
9Ø4Ø  NEXT I8
9Ø5Ø  RETURN
9499  REM**READ DATA FROM A FIXED POSITION
95ØØ  XX=Ø:FI=Ø
951Ø  PRINT CHR$(14);:REM**CURSOR ON
952Ø  YY$=INKEY$
953Ø  IF YY$="" THEN 952Ø
954Ø  IF YY$=CHR$(13) THEN PRINT CHR$(15);:
      REM**NEW LINE?
955Ø  IF YY$=CHR$(8) AND FI THEN XX=XX/1Ø:FI=FI-1:
      PRINT YY$;:GOTO 952Ø:REM**BACKSPACE
956Ø  IF YY$<"Ø" OR YY$>"9" THEN 952Ø:REM**DIGITS ONLY
957Ø  PRINT YY$;
958Ø  XX=XX*1Ø+VAL(YY$):FI=FI+1:GOTO 952Ø
9999  REM**SET UP THE DATA BASE
1ØØØØ FZ=-1:REM**SET FLAG
1ØØ1Ø GOSUB 6ØØØ
1ØØ2Ø FZ=Ø:REM**CLEAR FLAG
1ØØ3Ø RETURN
```

Listing 1. The complete Pools program

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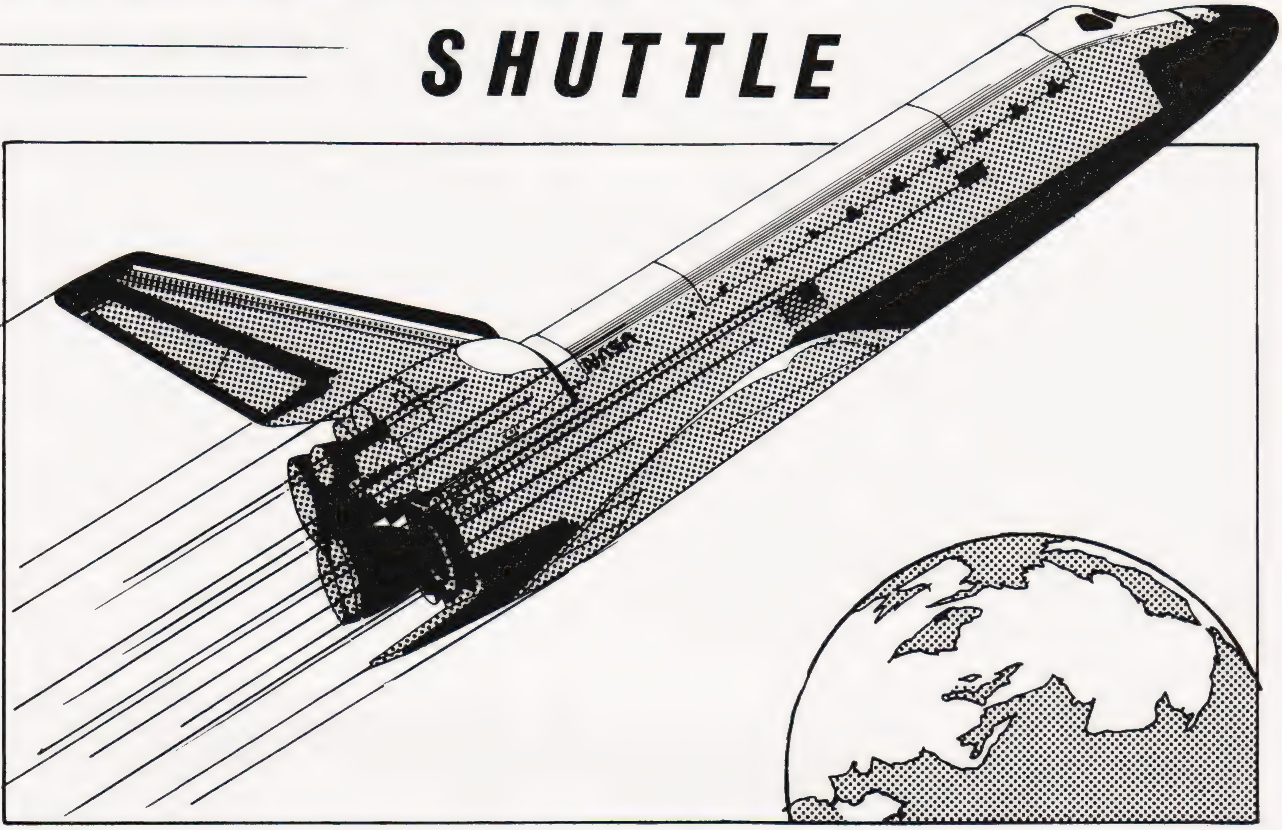

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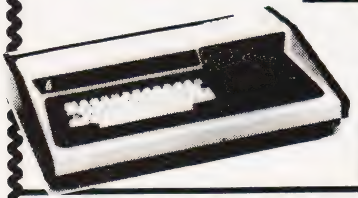

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LINE PLOTTER

Paul B Kaufman

Making the most of Microtan's chunky graphics

This pair of machine code routines allows lines to be drawn on the Microtan screen at high speed between any two points and at any angle. Both routines are directly accessible from BASIC using the USR command.

Listing 1 is an extended version of the Microtan manual's graphics routine. XCOORD and YCOORD are set up with the X and Y co-ordinates respectively. MODE is set to one of three values:

1) $FF — Erase graphics dot at position XCOORD, YCOORD
2) $01 — Set graphics dot at position XCOORD, YCOORD
3) $00 — Test graphics dot at position XCOORD, YCOORD

Mode is returned as 1 if bit is set, 0 if not set.

This routine may be called independently of the program in Listing 2.

Drawing Lines

There are several ways of drawing lines on a microcomputer. One way would be to start at one end of the line and continually increment the X and Y co-ordinates while plotting until the end of the line is reached. This may be simply expressed as:

$$X = X0 + I^* (X1 - X0)$$
$$Y = Y0 + I^* (Y1 - Y0)$$

where: X and Y are new co-ordinates to be plotted
X0 and Y0 are start co-ordinates of line
X1 and Y1 are end co-ordinates of line

and I is the increment which varies from 0 to 1. This may be considered as the fraction of the whole line which is to be plotted at any one time. Although this method is reasonably simple to code in BASIC, problems arise for the machine-code programmer in handling fractional numbers which are needed to represent I.

Another method, which is the one used here, is to repeatedly divide the line in half, saving the results of each division until division cannot go any further. The resulting co-ordinates are a single point. This point is then plotted and the division process then starts again and continues until the end of the line is reached. The most efficient method of storing the intermediate points is to push them onto the stack. This makes for faster processing and economy of memory usage.

Using The Programs

Enter the code from listings 1 and 2. If you are using BASIC, answer 'MEMORY SIZE' with : 7670 to protect the machine code area. Listings 3 and 4 are the same routines expressed as data statements which may be easier for the BASIC programmer. For convenience a 'clear-screen' routine is included in the listings. The following steps are then followed to run the routines.

1) To clear screen: JSR $1F94 or in BASIC:
POKE34,148:POKE35,31:DUM=USR(DUM)

2) Set, Clear or Test graphics bit: Enter X and Y co-ordinates at $40 and $41 with values between $0-$3F. Enter the MODE value at $3F as above and JSR $1F40. If testing a bit checking $3F will tell you if the bit is set or not. In BASIC use:

POKE 63, x-co-ordinate : POKE 65, y-co-ordinate (0-63)
POKE 63, mode (0 = test bit, 1 = set bit, 255 = clear bit)
POKE34,64 : POKE35,31 : DUM=USR(DUM)

3) Draw or Delete line: Set MODE ($3F) to required value. Set $40 and $41 with X and Y co-ordinates of start of line, $42 and $43 with co-ordinates of end of line then JSR $1E00. In BASIC do:

POKE 63, mode : POKE 64, start x : POKE 65, start y
POKE 66, end x : POKE 67, end y
POKE34,00: POKE35,30: DUM=USR(DUM)

A short demonstration program is given which imitates a radar screen. A line radiates from the centre of the screen to the edge. This line slowly rotates around the screen giving the 'radar' effect. To simplify matters the line is continually drawn and then followed by a clear screen. This could of course be changed to explicitly delete the line which has just been drawn.

These routines are a useful tool for the BASIC and machine-code programmer alike and could be the basis of many interesting games or demonstration programs. They also show what can be done with the limited (64 by 64) definition of Tangerine's chunky graphics.

References And Further Reading

The Mathematics of Computer Graphics, Byte, September 1978 and July 1979.
Vector Graphics for Raster Displays, Byte, October 1980.

Program Listing

```
003F  00          MODE    BYTE
0040  00          XCOORD  BYTE
0041  00          YCOORD  BYTE
0042  00          VDULO   BYTE
0043  00          VDUHI   BYTE
1F40  AD F0 BF    START   LDA $BFF0    ;Turn graphics on
1F43  A9 3F               LDA # $3F
1F45  C5 40               CMP $40
1F47  30 40               BMI $1F89    ;co-ordinates out of
                                        range
1F49  EA                  NOP
1F4A  38                  SEC          ;calculate screen
                                        address
1F4B  E5 41               SBC $41
1F4D  EA                  NOP
1F4E  48                  PHA
1F4F  29 03               AND # $03
1F51  AA                  TAX
1F52  68                  PLA
1F53  EA                  NOP
1F54  29 3C               AND # $3C
1F56  0A                  ASL A
1F57  0A                  ASL A
1F58  0A                  ASL A
1F59  85 42               STA $42
1F5B  A9 02               LDA # $02
1F5D  85 43               STA $43
1F5F  90 02               BCC $1F63
1F61  E6 43               INC $43
1F63  A5 40               LDA $40
1F65  4A                  LSR A        ;calculate graphics byte
1F66  A8                  TAY
1F67  A9 01               LDA # $01
1F69  90 01               BCC $1F6C
1F6B  0A                  ASL A
1F6C  CA                  DEX
1F6D  30 04               BMI $1F73
1F6F  0A                  ASL A
1F70  0A                  ASL A
1F71  D0 F9               BNE $1F6C
1F73  AA                  TAX
```

```
1F74  A5 3F                LDA $3F        ;check mode
1F76  30 08                BMI $1F80      ;clear pixel?
1F78  F0 10                BEQ $1F8A      ;test pixel?
1F7A  8A                   TXA
1F7B  11 42                ORA ($42), Y
1F7D  91 42                STA ($42), Y   ;switch pixel on
1F7F  60                   RTS
1F80  8A        CLEARPIX   TXA            ;delete pixel
1F81  31 42                AND ($42),Y
1F83  F0 04                BEQ $1F89
1F85  51 42                EOR ($42), Y
1F87  91 42                STA ($42), Y
1F89  60                   RTS
1F8A  8A        TESTPIX    TXA            ;test pixel
1F8B  31 42                AND ($42), Y
1F8D  F0 04                BEQ $1F93
1F8F  A9 01                LDA # $01
1F91  85 3F                STA $3F
1F93  60                   RTS            ;return
1F94  A9 00     CLEARSCR   LDA # $00      ;short routine to clear
                                          screen
1F96  AA                   TAX
1F97  9D 00 02             STA $200,X
1F9A  9D 00 03             STA $300,X
1F9D  E8                   INX
1F9E  DOF7                 BNE $1F97
1FA0  60                   RTS
```

Routine to set, clear or test graphics pixel.

```
0040  00        START X    BYTE
0041  00        START Y    BYTE
0042  00        END X      BYTE
0043  00        END Y      BYTE
1E00  A9 FF     ENTRY      LDA # $FF      ;prepare stack
1E02  48                   PHA
1E03  48                   PHA
1E04  A5 40                LDA $40        ;if start>end co-
                                          ordinates
1E06  C5 42                CMP $42        ;then exchange
1E08  30 10                BMI $1E1A
1E0A  A8                   TAY
1E0B  A5 42                LDA $42
1E0D  85 40                STA $40
1E0F  98                   TYA
1E10  85 42                STA $42
1E12  A4 43                LDY $43
1E14  A5 41                LDA $41
1E16  84 41                STY $41
1E18  85 43                STA $43
1E1A  A5 42     LOOP       LDA $42        ;are start x and end x
                                          the same?
1E1C  C5 40                CMP $40
1E1E  F0 2B                BEQ $1E4B      ;Yes
1E20  48                   PHA            ;No
1E21  18                   CLC
1E22  65 40                ADC $40        ;Find centre of line
                                          (x-co-ordinates)
1E24  4A                   LSR A
1E25  85 42                STA $42        ;save it
1E27  AA                   TAX
1E28  E8                   INX
1E29  A5 43                LDA $43
1E2B  48                   PHA
1E2C  A5 41                LDA $41        ;are start y and end y
                                          the same?
1E2E  C5 43                CMP $43
1E30  F0 11                BEQ $1E43
1E32  18                   CLC            ;No
1E33  65 43                ADC $43        ;find centre of line
1E35  4A                   LSR A
1E36  85 43                STA $43
1E38  C5 41                CMP $41
1E3A  B0 04                BCS $1E40
1E3C  E6 43                INC $43
1E3E  50 03                BVC $1E43
1E40  18                   CLC
1E41  69 01                ADC # $01      ;adjust centre
1E43  A8                   TAY            ;save co-ordinates
1E44  8A                   TXA
1E45  48                   PHA
1E46  98                   TYA
1E47  48                   PHA
1E48  4C 1A 1E             JMP $1E1A      ;start again   (Loop)
1E4B  A5 41                LDA $41
1E4D  C5 43                CMP $43
1E4F  F0 0D                BEQ $1E5E
1E51  A5 42                LDA $42        ;save Y co-ordinate
1E53  48                   PHA
1E54  A5 43                LDA $43
1E56  48                   PHA
1E57  A6 40                LDX $40
1E59  A5 41                LDA $41
1E5B  4C 32 1E             JMP $1E32
1E5E  8A                   TXA
1E5F  48                   PHA
1E60  20 40 1F             JSR $1F40      ;plot co-ordinates
1E63  68                   PLA            ;bring back co-
                                          ordinates
1E64  AA                   TAX
1E65  68                   PZA
1E66  85 41                STA $41
1E68  68                   PLA
1E69  85 40                STA $40
1E6B  C9 FF                CMP # $FF      ;no more co-ordinates?
1E6D  D0 01                BNE $1E70
1E6F  60                   RTS            ;return
1E70  68                   PLA
1E71  85 43                STA $43
1E73  68                   PLA
1E74  85 42                STA $42
1E76  4C 1A 1E             JMP $1E1A      ;continue round
```

Routine to plot a line between two points.

```
20000 FOR I = 8000 TO 8096: READ V:POKE I,V:NEXT
21000 DATA 173,240,191,169,63,197,64,48,64,234
21500 DATA 56,229,65,234,72,41,3,170,104,234,41,60
22000 DATA 10,10,10,133,66,169,2,133,67,144,2,230,67
22500 DATA 165,64,74,168,169,1,144,1,10,202,48,4,10,10
23000 DATA 208,249,170,165,63,48,8,240,16,138,17,66
23500 DATA 145,66,96,138,49,66,240,4,81,66,145,66
24000 DATA 96,138,49,66,240,4,169,1,133,63
24500 DATA 96,169,0,170,157,0,2,157,0,3
25000 DATA 232,208,247,96
```

BASIC program to load listing 1.

```
40000 FOR I = 7680 TO 7800:READ V;POKE I,V:NEXT
41000 DATA 169,255,72,72,165,64,197,66,48,16,168,165,66
41500 DATA 133,64,152,133,66,164,67,165,65,132,65,133
42000 DATA 67,165,66,197,64,240,43,72,24,101,64,74
42500 DATA 133,66,170,232,165,67,72,165,65,197,67,240
43000 DATA 17,24,101,67,74,133,67,197,65,176,4,230
43500 DATA 67,80,3,24,105,1,168,138,72,152,72,76,26
44000 DATA 30,165,65,197,67,240,13,165,66,72,165,67
44500 DATA 72,166,64,165,65,76,50,30,138,72,32,64,31
45000 DATA 104,170,104,133,65,104,133,64,201,255,208,1
45500 DATA 96,104,133,67,104,133,66,76,26,30
```

BASIC program for loading listing 2.

```
10   REM** INITIALISE
20   GOSUB 20000
25   REM** CLEAR SCREEN
30   GOSUB 2000
40   X1 = 32:Y1 = 32:REM** SET UP SCREEN CENTRE
50   X = 1:FOR Y = 1 TO 62 STEP 2:GOSUB 1000:GOSUB
     2000:NEXT Y
60   Y = 63:FOR X = 1 TO 62 STEP 2:GOSUB 1000:GOSUB
     2000:NEXT X
70   X = 63:FOR Y = 62 TO 1 STEP -2:GOSUB 1000:GOSUB
     2000:NEXT Y
80   Y = 1:FOR X = 62 TO 1 STEP -2:GOSUB 1000:GOSUB
     2000:NEXT X
100  GOTO 50
999  END
1000 POKE 63,1:POKE 64,X:POKE 65,Y:POKE 66,X1:POKE 67,Y1
1100 POKE 34,0:POKE 35,30:DUM = USR(DUM)
1200 RETURN
2000 POKE 34,148:POKE 35,31:DUM = USR(DUM):RETURN
```

Radar simulation to be used with listings 3 and 4.

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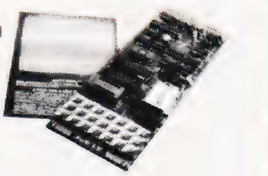

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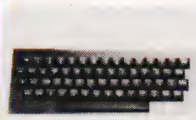

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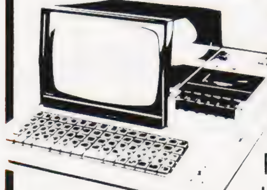

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Not fifth but FORTH, a language that builds itself

FORTH is an unusual computer language, originally developed over 10 years ago by an American, Charles Moore, as an alternative to existing high-level languages. Its early uses included operating systems for the control of Radio Telescopes. Today, FORTH has developed into a powerful and easily implemented high-level language with a rapidly growing group of hobbyist enthusiasts both in this country and America. Although FORTH was developed for control applications, its vocabulary can easily be expanded to include additional program structures, for example, Pascal-like CASE statements, and data types. These extensions allow a wide range of different problems to be solved using FORTH. Moreover, FORTH allows programmers to develop their own special vocabularies and also allows easy access to all the software and hardware components of the computer being programmed.

Structure And Syntax

FORTH is both an interpreter and a compiler; merged within its structure are the best features of an interactive interpreter and a run-time execution system which produces program execution times similar to those achieved by a native code compiler.

Its syntax is different from that of other high-level computer languages. Consider the following example — a program to add the numbers 2 and 3, and then display the result on a VDU.

```
2 3 + .
5 OK
```

FORTH employs the reverse Polish notation, where numbers are entered in an expression prior to operators. This mode of operation is also adopted by a number of popular calculators, notably Hewlett Packard's.

In the above example the numbers 2 and 3 are pushed onto a parameter stack as the FORTH program text is scanned from left to right. The operator '+' adds the top two numbers on the parameter stack and places the result back on the top of the parameter stack. Finally the operator '.' removes a number from the top of the parameter stack and outputs it to the display VDU. Most implementations of FORTH echo the word OK to the VDU to signify that the previous operations were completed successfully.

The operators which compose a FORTH program are called words. The FORTH language consists of a dictionary of these words, linked together to form a list, and a small segment of machine code which is the kernel of the FORTH interpreter. The dictionary accounts for over 95% of the language.

The fundamental FORTH dictionary is roughly 40 primitive words long. Each primitive is usually written in machine code. New words are defined in terms of the primitives. In FORTH, as soon as a new word is defined it may be executed immediately or used to create additional words. FORTH does not use argument lists. Routines communicate through the parameter stack. However, FORTH does allow programmers to define variables but these variables are themselves operations which, for example, place the address in memory of the variable on the top of the parameter stack. This implies that FORTH programmers can not only extend the language by adding new words to the dictionary, but can also create their own variables or data types.

Rolling Your Own

When writing FORTH programs the process used to develop a new program is straightforward but different to, say, BASIC. Let us consider a second example. Imagine that we wish to tabulate a list of the cubes of a series of positive numbers. The first step is to create and add to the dictionary a FORTH word which calculates the cube of a number. The following fragment taken from a FORTH programming session at a terminal shows the FORTH code for a word called CUBE. Once a new word is defined it may be tested before use in other sections of the program under development.

```
: CUBE
  DUP DUP
   *   *
```

The definition of a new word starts with the FORTH defining word colon ':' which is followed by the name of the new word, CUBE in our example. The body of the new word then follows, being terminated by the FORTH word semicolon ';'. Notice that each word is separated by a space or a carriage return at the end of a line. Also that the body of the word may extend over many program lines. The word colon ':' is one of the FORTH operations called 'defining words'. A defining word takes the next word in the input sequence, from a terminal or mass storage device, and prepares a dictionary entry for the new word. The word colon also switches the FORTH language into the compile mode so that the words which follow the name of the new word are compiled into the dictionary and not executed immediately. The FORTH language stays in the compile mode until the word semicolon ';' is read from the input device.

Testing the word CUBE is simply done by entering, at the terminal, test data, and the name CUBE, for example

```
5 CUBE .
```

followed by a carriage return. FORTH responds with

```
125 OK
```

The word CUBE expects to find the number to be cubed on top of the parameter stack. If we look at the body of the word CUBE the first word in the body is DUP. This word duplicates the number on the top of the parameter stack. The second DUP repeats the same operation. Hence, if the number 5 was on top of the parameter stack, following execution of the words DUP DUP we have 5, 5, 5 on the parameter stack. The word sequence ** is next. The FORTH word '*' takes the top two numbers on the parameter stack, multiplies them together and places the result back on the top of the parameter stack. Hence, after execution of the first '*' the parameter stack becomes 25, 5, and after execution of the second '*' the top of the parameter stack holds the number 125.

To compute a table of CUBES we must define a second word, which we will call TABLE.

```
: TABLE
  10  0
  DO
       CR  I  .  I  CUBE .
  LOOP
;
```

Again, testing the word TABLE is simply done by entering at the terminal the name TABLE followed by a carriage return. FORTH responds with

```
0     0
1     1
2     8
3    27
4    64
5   125
6   216
7   343
8   512
9   729    OK
```

The word TABLE uses the previously defined FORTH word CUBE to calculate the cube of a number. TABLE also demonstrates a number of additional FORTH features. The DO . . . LOOP is a structured loop with a counting index incremented in unity steps. DO takes two arguments from the parameter stack, the 10 and 0 in the example TABLE. The initial value, 0 is the top item on the parameter stack. These loop parameters are written in the reverse order to most other high-level languages. The word 'CR' simply prints a carriage return on the VDU. The FORTH word 'I' causes the current value of the loop counter to be pushed onto the top of the parameter stack. The loop counter is stored on a second stack called the return stack.

Taking The Time

Although FORTH programs are interpreted the execution of FORTH words is in general very much faster than the same program written in BASIC. The next FORTH example demonstrates a timing benchmark. The FORTH word TIME computes 30000 empty loops. On a typical 8-bit microprocessor, TIME executes in roughly 4 S. The same loop executed by an Integer BASIC interpreter takes approximately 40 seconds.

```
: TIME 30000 0 DO LOOP ;
```

It is difficult to describe FORTH in detail because its extensible features allow each programmer to extend the language to solve the application which is being programmed. However, every FORTH implementation is characterised by a number of common elements; these are the dictionary, the parameter and return stacks, an inner and an outer interpreter, an assembler and a virtual memory management system.

The dictionary is an extensible threaded list of words, each entry in the list defines a word in the FORTH vocabulary. Two push-down stacks, the parameter and return stacks, are maintained by FORTH. These stacks are used to communicate arguments between words in a FORTH program. FORTH employs two interpreters; these are called the inner and outer interpreters. The outer interpreter is a conventional program for passing text strings from a terminal, and looking up each decoded word in the FORTH dictionary. If a word is found in the dictionary it is executed by calling the FORTH inner interpreter.

Unlike a BASIC interpreter the FORTH inner interpreter is very small, often 25 or less machine code instructions when run on an 8-bit microprocessor, which results in fast execution. The FORTH inner interpreter execution speed, although slower than that obtained with an optimised assembly code program, is often as fast as the run-times achieved by the code generated by an 8-bit native code compiler. In the future, when the next generation of 16-bit microprocessors are adopted for personal computers, microprocessors like the ZILOG Z8000 and the Motorola 68000 will allow FORTH interpreters to run at even higher speeds. The speed will probably be in the region of 20 to 40 times faster than that obtained by an 8-bit microprocessor BASIC interpreter.

Most FORTH implementations include a resident machine code assembler which is used to create words constructed from machine code segments or to immediately execute machine code instructions. This language facility is important when programming critical timing operations or when controlling peripheral devices. FORTH assemblers use the reverse Polish notation with the assembler mnemonics following their arguments. Fully structured assembly programming is defined in the FORTH assembler syntax through the use of structured sequences which include IF...ELSE...THEN and other constructions.

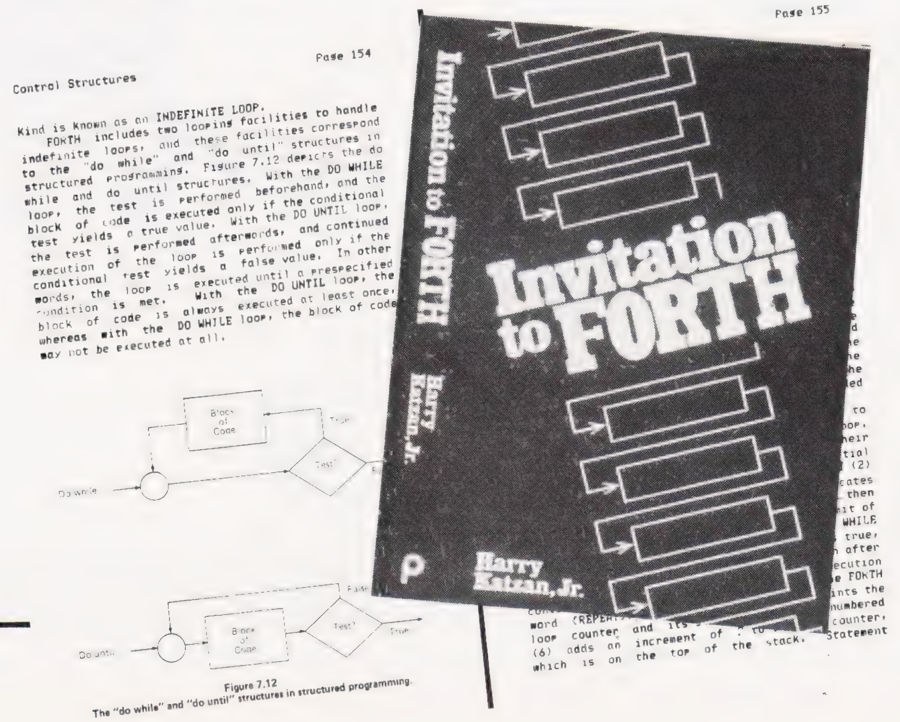
In common with other computer languages, some form of mass storage device is necessary to store FORTH source programs and test data. FORTH defines a virtual memory system based on blocks which are fixed-length segments of disc space. These blocks may contain programs or test data. A number of buffers are also held in random access memory, so that the blocks can be lead into the buffers automatically from the mass storage device. If a block is modified in memory it is automatically replaced on disc by the new version. This virtual memory management scheme removes the need for explicit mass storage read and write operations and hence the storage of FORTH programs and test data is independent of the mass storage operating system. Associated with the FORTH virtual memory scheme is a text editor which provides a means to edit program source texts. Normally both line and character editing facilities are supported.

How To Get It

The FORTH language is in the public domain and has been implemented on the majority of popular microprocessors, including the 808, Z80, 6800, 6502, 6809 and, more recently, the 16-bit 8086 microprocessor. Each implementation of the language varies in size from a 2K to 3K language subset to a 16K to 20K versions which include the machine code and virtual memory management language components.

The FORTH Interest Group, PO Box 1105, San Carlos, CA 94070, USA, publishes FORTH source listings and installation instructions to help programmers get started with FORTH. The following articles and texts are also worth reading.

1. Moore, C H, *The Evolution of FORTH, an Unusual Language,* Byte, August 1980, pp 76-92.
2. Fritzson, R, *Write your own FORTH interpreter,* Microcomputing, February 1981, pp 76-92.
3. Fritzson, R, *Write your own Pseudo-FORTH compiler,* Microcomputing, March 1981, pp 44-57.
4. Loeligen, R G, *Threaded Interpretive Languages,* Byte Books, 1981.
5. Forth Inc, *Using FORTH,* 1980.
6. Stevens, *A FORTH primer,* Kit Peak, 1979.



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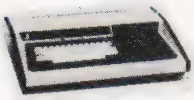

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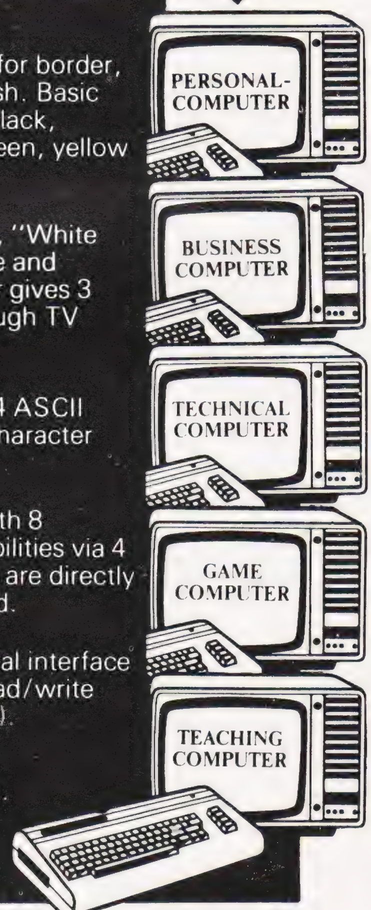

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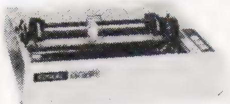

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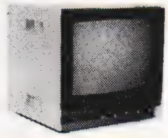

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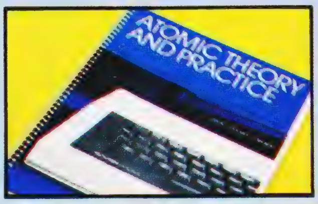

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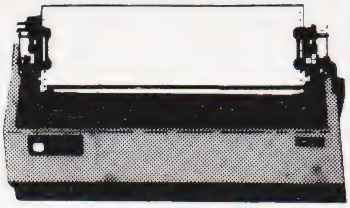

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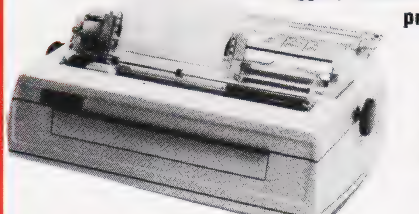

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NASCOM SUMCHECKER

Pete Dann

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Many exciting machine code programs written for the NASCOM 2 are published in a Hex tabulation form, using the 'T' command. On hard copy this produces a useful checksum at the end of each line of 8 bytes.

```
1000  31 00 10 21 0F 0D 36 0D D1
 ↑                            ↑
address of first          checksum
following byte
```

When tabulating on a monitor screen, however, the checksum is erased.

Having spent an hour or so punching in a few K, the first sensible thing to do on completion is to save a copy on tape ('W' command) and verify the copy ('V' command). Next you might like to check that you have typed every byte correctly, or you may be too eager to wait and want to try to run the program straight away.

What happens then if things start going wrong? Simple, just load the copy back from tape, enter the following short routine anywhere you have a few spare bytes and execute it supplying the starting address of the program you wish to investigate. If you load the routine at 0C80H to check a program at 1000H then type:

E 0C80 1000 (NL)

Pressing any key will then produce an address followed by the checksum for the eight bytes following that address (inclusive). To get subsequent checksums just keep pressing any key. To return to NAS-SYS type 'ESC'.

```
DF 60                 SCAL ARGS
EB                    EX DE,HL
CF           LOOP1    RST RIN
FE 1B                 CP 1BH
20 02                 JR NZ, CONT
DF 5B                 SCAL MRET
0E 00        CONT     LD C,0
DF 66                 SCAL TBCD3
EF 09 20 00           SCAL PRS "→"
06 08                 LD B,8
7E           LOOP2    LD A,(HL)
81                    ADD A,C
4F                    LD C,A
23                    INC HL
10 FA                 DJNZ LOOP2
79                    LD A,C
DF 68                 SCAL B2HEX
DF 6A                 SCAL CRLF
18 E2                 JR LOOP1
```

NON-STOP PET

Colin Mair

Keep your code running

If you've ever accidently hit the STOP KEY on your PET it can, to say the least, be annoying, and in a control process or real time application it can be disastrous.

The easiest method of disabling the STOP is to change the Interrupt Request Vector, in order to bypass the routine which detects the pressing of the STOP key. This unfortunately prevents the running of the real time clock, so TI cannot be used for timing, control or as a random seed for RND.

This machine code routine resides in the second cassette buffer and when switched on, by a SYS 826, slots into the interrupt routine. When an interrupt occurs the operating systems combined Clock Update and Stop Key Test subroutine is done first. If the STOP key was pressed EFH will be placed in location 9H. This location is thus tested for EFH and if found it is replaced by FFH. The next stage is to exit to the rest of the interrupt routine including the Action Stop Key routine. This subroutine of course can never see the required EFH in location 9H.

There is also a routine included which, when operated by a SYS 853 command, resets the interrupt routine to normal. This is required when handling data to or from a cassette.

The BASIC Loader Program can be used to place the required machine code into the cassette buffer.

The following alterations have to be made for 2000 Series ROMs.

```
SKEY    = $209H
IRQV    = $219H
INT     = $8503H
NINT    = $8500H
```

Program Listing

```
033A  78                  SEI   SET LOCATION 826
033B  A9  45              LDA   #<START
033D  85  90              STA   IRQV
033F  A9  03              LDA   #>START
0341  85  91              STA   IRQV+1
0343  58                  CLI
0344  60                  RTS
0345  20  EA FF START     JSR   CLOCK
0348  A5  9B              LDA   SKEY
034A  C9  EF              CMP   #$EF
034C  D0  04              BNE   OUT
034E  A9  FF              LDA   #$FF
0350  85  9B              STA   SKEY
0352  4C  31 E6 OUT       JMP   INT
0355  78        RESET     SEI   RESET LOCATION 853
0356  A9  2E              LDA   #<NINT
0358  85  90              STA   IRQV
035A  A9  E6              LDA   #>NINT
035C  85  91              STA   IRQV+1
035E  58                  CLI
035F  60                  RTS
```

```
10   READ SA,N
20   FOR I=1 TO N
30   READ MC
40   POKE SA,MC
50   SA=SA+1
60   NEXT I
70   DATA 826, 39
80   DATA 120, 169, 69, 133, 144, 169, 3, 133, 145, 88
90   DATA 96, 32, 234, 255, 165, 155, 201, 239, 208, 4
100  DATA 169, 255, 133, 155, 76, 49, 230, 120, 169, 46
110  DATA 133, 144, 169, 230, 133, 145, 88, 96, 133
```

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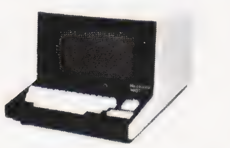

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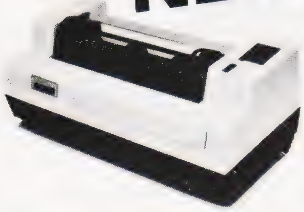

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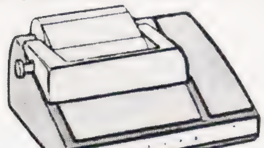

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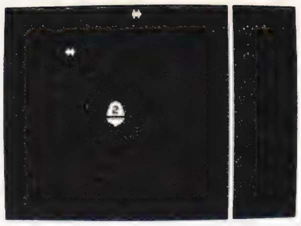

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Breakout Score points knocking bricks from wall. Ball has two changes of angle and speed. Program 3K, graphics 1-2K. COLOUR

GAMES PACK 2
Dogfight Two-player game; each player controls a plane and tries to shoot down his opponent without crashing. Program 4K, graphics 6K.
Mastermind Guess the computer's code before the computer guesses yours; program 3K, graphics ½K.
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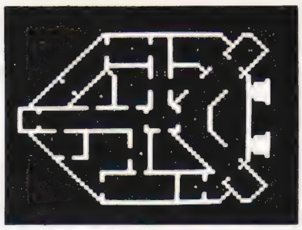
Snake Grow yourself a snake by guiding it towards digits which it eats. Program 2K, graphics ½K.



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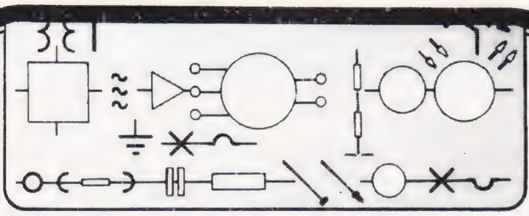

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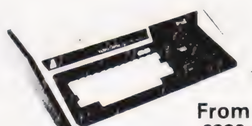

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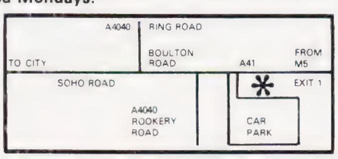

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SYSTEM SELECTION

A P Stephenson

Understanding the roles of each part of a system enables the first time buyer to make a better choice

Choosing a washing machine is not too difficult a task. Within a certain price bracket, apart from appearance, there are no major variations. They all accept dirty clothes, water and froth-producing chemicals as INPUT, perform some form of agitation PROCESS and finally OUTPUT the clothes again minus the muck. The machine is thus dedicated to the primitive function of washing clothes and could never be used as, say, an electric toothbrush. Most consumer goods are limited to a single or closely related dedicated function.

Microcomputers, however, are strange animals, possessing no clearly definable function. We could of course concoct a definition which describes the machine from a computer scientist's viewpoint but, like many definitions which close all loopholes, it would probably end up as little more than an impressive label. Provisionally, we could say the function is to store and run programs but this begs the question 'what is a program?'. A program is how you explain to the machine what you want it to do. But what you want it to do may be quite unique and never envisaged during the design stage of the machine. We thus have a black box which was designed in total ignorance of its eventual use!

It is this vagueness of function which sets the computer apart from all other consumer goods and responsible for the almost agonising difficulties associated with choosing Brand X from Brand Y. Fortunately you will not be short of advice. In fact, you will be saturated with it from all quarters. Full-page advertisements in the popular press are beginning to appear, screaming out the subtle advantages of this and that machine. Computing magazines regularly print reviews of particular models. And, last but not least, there is the onslaught of advice from friends or acquaintances in the know who already possess a machine. Be careful how you respond to advice from these well intentioned people. They may be expert in their subject but, quite unconsciously, may display bias in favour of their own machine. It is remarkable how fanatical computer groups can be regarding the merits of their own system. We encounter, for example, the 'Apple' group who often look with ill-disguised disdain at the 'PET' group. A member of the 'Sharp' or 'Tangerine' group may walk on the other side of the pavement to avoid passing one of the 'Tandy' group. Then, of course, we must try and understand the type who having bought machine 'X' wishes he hadn't, a revelation usually hammered home by furious verbal attacks on its supposed deficiencies and exaggerated praise of machine 'Y'.

The sum-total of all these conflicting pressures does little towards the task of choosing a machine for the first time and even less for exchanging the present one in favour of a 'better' one.

Do I Really Need A Computer?

It is logical to probe your motives before even thinking which particular model to buy. 'Need' and 'want' are often confused when they coexist with enthusiasm so it is wise to re-phrase the question to the 'want' form. Strangely, it may turn out after many months of owning a microcomputer that the original 'want' has, in the light of experience, turned into 'need'. This may be the natural result of gradually increasing insight into the potential of the device . . . the application horizon expands with use. Let us list a few of the reasons for wanting a microcomputer.

It is fashionable. This may be considered a superficial reason but few of us are entirely immune from the dictates of fashion.

It is a hobby. One advantage peculiar to hobbies is freedom from the need of justifying it. Some people spend much of their spare time and money collecting old coins or butterflies or stamps. Others design and build model railways or fly model aircraft. The more adventurous may even drape themselves in expensive rubber and gurgle their way down to the polluted depths of rivers just to confirm there is nothing there except mud. In fact it is fortunate for some of the more bizarre hobbyists that justification is not mandatory.

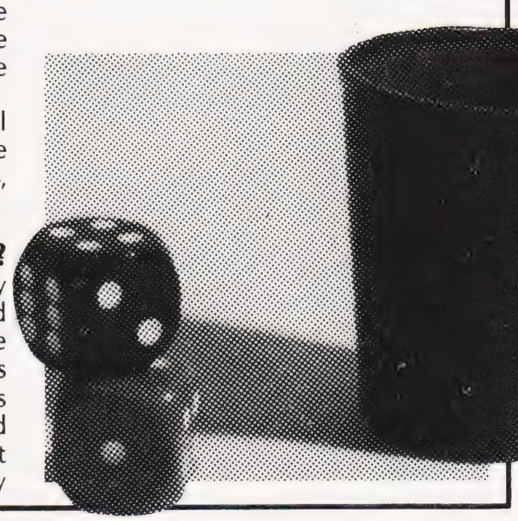
It expands the potential of an existing hobby. Many model railway enthusiasts are now finding the advantages of computer controlled activities on the tracks. This is an example in which the computer would play a subordinate role to the main interest.

It is a tool. This is the conventional role of the computer and is of proven use in the fields of mathematics, physics, engineering, commerce and education.

Which Is The Best Computer?

This question is worth asking, if only to illustrate its absurdity. Over and above the task of sifting through the mass of technical specifications there is a grey area in which subjective factors demand recognition. Bearing in mind that the cost is almost always the most important parameter, the choice really boils down to which is the best computer for *your* purposes within the price bracket *you* can afford. Within these terms of reference, it is useful to write down the factors involved before making a final choice. The following remarks are intended to be general and as far as possible, made without reference to specific makes in order to prevent the writer's personal feelings tainting the arguments.

However much money you can afford, there will always be a model costing just those few pounds more which seems more attractive. The old adage 'you get what you pay for' is not necessarily true with computers although it is still a broad guide. Prices vary enormously, not only between different models but between different months. The cost of the basic processor can vary somewhere within the extremes of £70 and £2,000. A gentle warning may not be out of place for those who are considering buying at the very low end of the market simply because the model represents 'good value for money'. The initial joy of ownership could soon give rise to irritation. Glossy adverts, quite naturally, highlight the merits but conveniently supress those niggling little deficiencies. The engineering and marketing skills necessary to launch a microcomputer for less than £100 deserves admiration. That it works at all is surprising. Unfortunately it may work sufficiently well to generate (but not quite well enough to sustain) enthusiasm. If about £70 is the absolute maximum you can afford (or are prepared to spend) then by all means go ahead. However, if you can afford more by waiting a few months you may avoid the humiliation and expense of an upgrading exercise shortly after the original purchase.



Memory (RAM)

The amount of Read/Write memory (RAM) supplied as 'standard' and available to the user for programs is one of the important (if not the most important) parameters of the specification. The cost of RAM has shot down over the last few years, consequently it would not be extravagant to demand that at least 16K should now represent the *minimum* required to write programs of real practical value. Most microprocessors in current use have 16 wires on the address bus which imposes an absolute maximum of 64K (2^{16} = 65,536 = 64*1024 = 64K) on the amount of memory which can be directly addressed. But this figure refers to total memory inclusive of the ROM operating system requirements. Thus microcomputers can seldom offer more than 48K of directly addressable RAM.

The Keyboard

This must surely be the major peripheral in the computer, and is often taken for granted in favour of the more exotic add-ons. A poor keyboard will always detract from the pleasure of using a machine so it would be well to consider some of the points which need watching.

First of all the layout of the keys themselves should ideally follow closely the pattern of the standard QWERTY keyboard of the office typewriter. This is not to say that the QWERTY is a well designed arrangement of the keys. In fact, it was planned originally to deliberately slow down the speed of typing in order to prevent the large mechanical levers of the first machines betraying their inertia. However, we are stuck with it and it is probably too late in the day to change tradition. Remember that if the keyboard is non-standard, you may get used to it but you will have to learn all over again if the machine is changed. However, one or two little variants have crept in which have become almost a standard in computer keyboards as distinct from the office typewriters. One popular variant is an extra numerical keyboard with the common arithmetic operator keys thrown in and situated on the right of the main keyboard. This arrangement is particularly suited to computers because of the greater use of numerical input. Where such a keyboard does appear, it is desirable that the numeric keys are repeated on the main keyboard in their usual position on the top row. In this way, the conventional typist can still feel at home.

Memory (ROM)

For a computer to function as a human oriented device, there must be programs permanently resident in the machine. Such programs are held in ROM which is 'Read Only Memory'. The functions carried out by the programs in ROM come under the general heading of the Operating System. This handles mundane but highly important tasks such as detecting when you have pressed a key, which key it was, and displaying the character on the monitor or television screen. It must also allow you to correct mistakes in your program, erase unwanted lines, LIST or RUN your programs, SAVE and LOAD them, etc. Also in ROM is the translation program which allows you to write in a so-called 'high level' language such as BASIC. This program is normally called an Interpreter.

Although the *hardware* of different machines vary in some respects, they are all broadly similar in fundamental architecture . . . they all operate as 'Von Neuman' machines. Von Neuman (1903-1957) was the most influential of the computer pioneers. Almost all digital computers, whether they are the giant 'mainframe', minicomputer or microcomputer, are designed along the lines of his original draft papers.

The major difference in machines, the characteristic which decides the personality of each one, is due mainly to the in-built sophistication of the ROM operating system and translator program. In short, the program *already inside* the machine when you buy it will determine how pleasant it will be to write or operate your own programs. As a crude yardstick, the larger the ROM the more 'friendly' will the computer be. Thus if two machines, in other respects about equal, differ in the size of their ROMs, the one with the larger would probably turn out to be the 'better' model. This conclusion assumes that the programs in the ROMs have been written by equally competent experts who know how to cram the highest possible sophistication into the smallest possible ROM. We must remember that it would be possible but fortunately high improbable for an unscrupulous manufacturer to offer a large ROM but with only half of it dedicated to tight software; the remaining space containing little more than padding. With regard to actual size, a total ROM complement of less than say 12K could not be expected to offer much in the way of refined conversations between machine and user.

Apart from the resident ROMs, we find that many models have a few empty IC sockets on the circuit board enabling you to insert extra ROMs. These can be very useful in the future for using the various pre-programmed ROMs which are now springing up almost every month. They are all intended to augment the existing operating system. Perhaps one of the most well known is the 'Toolkit' for the PET range which, when plugged into the appropriate spare socket, provides the operator with some very powerful extras. Such ROMs can quite literally transform the versatility of a machine equivalent almost to an upgrade and there is little doubt that many more of them, offering even greater advantages, are still to come rolling out of the software mills. Yet another advantage of spare ROM sockets is the facility to plug in your own EPROM containing the extras which are specifically desirable for you.

Screen Format

Next to the keyboard, the number of characters available per line must be the major factor in programs which are predominantly text oriented. Most microcomputers manage 40 characters per line, which is a pity. Because of the short print line, it is tempting to preserve display space by allowing words to wrap around and finish on the next line which, to say the least, looks scruffy. The restrictions imposed by the 40 character limit are particularly apparent when displaying information in tabular form . . . there never seems to be enough room to squeeze in the columns needed. The ability to display say, 80 characters, must be considered an attractive feature when comparing different machines. There is, however, one important proviso; the resolution of the characters must be maintained. There is little point in increasing the length of the line if the characters are ill-defined and smudgy. The number of lines per screen page should ideally be 50 but 25 is more common. The actual shape (style) of the characters is a matter of personal taste.

Some computers offer colour. That is to say, it is possible to present the text in various colours under program control. Although by no means a necessity, there is no doubt that the ability to intersperse various colours in diagrams or pictures adds an entirely novel dimension to computing. Unfortunately, this luxury requires not only special circuitry in the computer (not in itself expensive) but the availability of a colour television. Few of us have two colour sets which means the computer addict must court unpopularity in the domestic scene by daring to 'borrow' the most important member of the family.

Graphics

It is remarkable how much significance is attached to the graphic characters often present on machines originally designed for the home computer market. It is not unusual for people to base their choice of a computer almost solely on the richness of the graphics repertoire. They are of course an advantage for quick programming of games but they will probably be phased out in time as more and more low-priced computers offer true high-resolution graphics. Graphic keys, after all, can only build the crudest of pictures on the screen and it is easy to tire of the depressingly similar conglomeration of blobs and thick squiggles posing as a battleship or submarine. With high resolution PLOT facilities, games can take on a more sophisticated form and offer a true medium for the artist in computer graphics. Another criticism of graphic keys is the waste of keyboard functions, the necessity to sacrifice the alternative character set of conventional lower case to make room for the blobs. There is something distasteful in the practice of relegating lower case characters to the indignities of a multidigit POKE number.

With regard to the actual mechanics of the keyboard, there are two primary divisions. Very cheap keyboards use a pressure pad idea to simplify the mechanics. Although these can be fairly reliable, they fail to inspire confidence due to the minute movement allowed before resistance is felt . . . you are never quite certain you have pressed the key sufficiently and the eyes must keep flashing up and down at the screen each time to confirm that contact has been made.

The conventional keyboard mechanics now appear to be classified as 'full-travel' in order to distinguish them from the cheaper variety. Most of them are very reliable although the odd particle of dust or coffee dregs can sometimes create a 'hole' in the keyboard. In very expensive keyboards (only found in the stockbroker belt) the normal electrical contacts have been replaced by Hall Effect keys which are free from the ravages of dirt. A sloping keyboard with a tiered structure is standard; flat boards, even if QWERTY in layout, are not liked by typists.

The number of different functions or characters delivered by each key should preferably be two and two only . . . the normal and the SHIFT function. Although often heralded as a 'powerful' feature in some machines to have three and sometimes four or more functions per key, it can be a nightmare remembering which pair (or trio!) of keys have to be pressed and in which order to dig out the required effect. In any case, it is non-standard and will have to be unlearned eventually. Another tendency which could creep in if not checked in time, is using one function to input each BASIC keyword on the grounds that it is 'quicker'. Quicker it may be but it smacks of the Oriental culture . . . single characters to represent each idea rather than the Western alphabetic system. It is *coded* language and therefore low-level.

High-Res Graphics

Since 'high' is a relative term some explanation may help. Most microcomputers employ a 'memory mapped' screen which means that characters to be displayed are first placed in a special area of RAM reserved for the purpose. Thus if there are 40 characters per line and 25 lines, this reserved area amounts to 1000 RAM locations. The operating system causes this area to be scanned regularly in order to up-date the screen display. With high resolution graphics, the smallest screen 'atom' is the single dot rather than the matrix of dots used to form conventional alphanumeric characters. The number of separately plottable dots which can be displayed is a measure of the screen resolution in 'high resolution' graphics. Thus, most computers boasting of this facility allow the programmer to choose the required resolution. For example, the choice offered might be:

160 x 256 plotting points
320 x 256 " "
640 x 256 " "
40 x 25 normal text

There is a penalty to be paid for high resolution . . . more RAM is required for the screen map and this is usually borrowed from the user's RAM. As an example, the highest resolution in the above table may require 20K of RAM which means that if you have say, a 32K RAM, system, only 12K will be left for the actual program . . . sufficient of a deterrent to avoid the highest resolution unless absolutely necessary.

Modulator Or Monitor

A manufacturer can obviously produce a microcomputer at lower cost if the display is left to the responsibility of the purchaser. An ordinary TV makes a quite satisfactory display for all except the most critical of us. The manufacturer has to supply, on the board, a small chunk of circuitry called a UHF modulator with a co-axial cable to the aerial socket of a TV.

When comparing costs, remember to take into consideration the cost of the TV. Although a UHF modulator works very well, the signal from the computer is obliged to circumnavigate some very unpleasant and complex tuning circuits before it finally arrives at its destination, the video amplifier area of the TV. Unfortunately, signals always gather 'dust' when they pass through each circuit and a certain amount of fuzz can appear around the edge of the characters.

A 'Monitor' is a specially designed screen display, containing no high frequency tuning circuitry. The signals from the computer are cleaner and fed directly to the video amplifier and deflection controls of the tube. Many of the popular microcomputers have a built-in monitor, presenting a nice integrated system with a display at least marginally superior to the UHF modulator. It is as well to note, however, that a good TV can sometimes outperform a poor monitor.

Some machines offer you a choice by the supply of an on-board UHF modulator and interface for direct connection to any of the standard monitors which can be bought separately. A word of warning: unless you are an electronics type or, better still an experienced TV engineer, never attempt to connect the monitor leads of the computer board to the video circuitry of a TV. Commercial TV sets have no mains transformer and consequently, the neutral side of the mains (which should be at ground potential but seldom is) is the chassis . . . the two 'earths' just don't mix and the result could be a charred, sorry-looking computer board.

The more wealthy among you may be considering the purchase of a computer which produces colour graphics in anything above medium resolution should seriously think about buying a colour monitor. This may, in some cases, almost double the cost of the system but the results are well worth it. The reason for this apparent extravagance is that a domestic colour TV cannot cope with the high switching speeds that the computer produces via the modulator. However, some of the more recent systems are being fitted with high bandwidth modulators and these go at least some of the way to curing the problem although they will never give that crisp 'monitor' image.

If you are buying a monitor, whether colour or B&W, do try to sit well back from it and not peer at each character. The sizes of the tubes vary from 9" to 12" and, although no firm evidence of radiation hazard has been found, you can suffer eyestrain.

Languages Supported

The language supplied in ROM for almost all popular makes of microcomputer is BASIC. It is continuously abused, sneered at and crucified by those who don't (or say they don't) use it and accepted with equanimity by those that do. To enter the arena demands courage and fanaticism. I have neither of these qualities so I shall take care not to invite the customary 'tut tuts' by trying to stick to facts only.

BASIC is fairly easy to learn (no language is exactly easy) but for long programs employing many twists and loops it is often difficult to trace bugs. It is popular, not only with computer hobbyists but with many members of the technical colleges and the universities. In spite of its defects it just won't go away! There are two features of BASIC which offend purists:

a) BASIC is an INTERPRETIVE language, meaning it is translated and executed line by line which imposes a time penalty on the run time . . . it has to be retranslated every time it is run.

b) It is said to be 'unstructured', meaning it was designed without regard for modular linkage. Structured languages enable each module of a program to be independently proved before slotting in.

In contrast, the language which is slowly gaining popularity (particularly in the higher echelons) is Pascal. It is highly structured and is a conventional COMPILED language. This means the program is completely translated (compiled) and then run. The compile time is relatively long but once compiled, it can be run at very fast speed. It takes longer to learn than BASIC but it has the advantage of almost forcing the learner to adopt sound programming techniques. Many of the machines available now support or intend to support Pascal as a second language although it is virtually essential for the compiler to be floppy disc based because of the massive compiler software required.

Those entering the computer scene *and* intending to include floppy discs in their system *and* those who are fashion-conscious would be well advised to insist on a machine which offers Pascal. They had better not waste too much time though; the rate at which new languages are coming out, and modifications to existing languages made, makes it probable that Pascal's popularity could wane.

Returning once more to BASIC, it is sad that so many niggling variants exist. The intention behind BASIC and indeed all high level languages is to mask the differences in hardware between different machines so that a program written for one machine will run on any other. But, like most ideals, they can seldom be realised and there are many dialects of BASIC in use. Various improvements have been made or some features left out in order to reduce the cost of implementation with the result that programs are seldom machine independent. Fortunately, it is not too difficult a task to incorporate a few modifications to make programs work on another machine. If a certain BASIC keyword doesn't exist in your machine, there will always be a way round it, somehow. To reduce cost a certain model may, for example, leave out the string-handling statements LEFT$, RIGHT$ etc, or perhaps only provide integer arithmetic. On the other hand, more ambitious models may include a collection of 'extra' goodies. Thus, most microcomputer BASICs only provide one inverse trig function ATN (arc tan) but some may include ACS (arc cos) and ASN (arc sin). A few offer MAT functions and perhaps some hyperbolics such as HTN (hyperbolic tan). Because of the lack of structure, some attempt to improve BASIC is taking place and we are beginning to see a few statements like IF . . . THEN . . . ELSE and REPEAT . . . UNTIL . . . creeping in to the more recent BASICs. This is admirable and should help in combatting one of the major criticisms. Another welcome sign is the abolition of the restriction to TWO characters when naming a variable which is another peace offering to the 'structurists'. Even the much-attacked interpretive nature of BASIC is now being conquered with the emergence of a new Compiled BASIC available on disc although a few cautionary words may not be amiss. It will still be easier to develop your program using 'ordinary' BASIC first and when the bugs are finally cleared, transform it to the compiled version. Once a program is compiled (and that could take minutes each time) it is then resident in machine code and *cannot* be easily modified without going back and re-compiling.

Other things being equal, including price, you would be well advised to pay particular attention to the list of BASIC STATEMENTS provided. If you are new to the game, use a crude yardstick and simply count them up . . . the one with the highest count will probably be the better buy because, as mentioned earlier, resident software in ROM is the most influential in determining the power of a computer from the user's viewpoint. As a quick test for many systems you can run the standard set of BASIC Benchmarks which we published in the October 1980 issue of CT.

Operating System

The section of the operating system which has the most direct effect on the operator is the provision of editing facilities. Incorrect characters or logical patterns which don't work are frequently entered at the keyboard by beginners and 'experts' so the ease with which corrections can be made will determine the overall friendliness of a machine. Editing procedures vary considerably. To correct a mistake in some machines, you have to re-enter the entire line again which can be irksome while in others the cursor controls in combination with a delete key can pinpoint and correct an offending character. Some systems change your entered line automatically and insert spaces to improve the appearance and readability of the listed program but this can be a mixed blessing if you wish to save memory by closing up the gaps. Whatever the editing system, it soon develops into an instinctive procedure so in some respects, the actual procedure itself is not too important.

Another feature of the operating system is the method by which the machine will inform you of syntax errors and other offences. The error messages can range from a simple code number which you have to look up or memorise (an awful method) or virtually plain English messages. The 'plain' English however is often subject to stringent abbreviations which detract from the plainness . . . REDO FROM START is an atrocious example of gobbledygook which hits us when an alpha character is entered into a numeric variable in response to an INPUT request.

It is because operating systems vary so much that attempts are made to standardise them so that not only the language but also the operating procedures will be machine independent. One system which is becoming increasingly popular is known as CP/M, a disc-based regime for which a large quantity of commercial software has been written. Consequently a machine which supports CP/M must be considered a favourable choice if you are more concerned with using commercial software than writing your own. CP/M (which stands for 'Control Program for Microprocessors') is at present operative only if the microprocessor in the machine is a Z80 (or 8080) which means that other chips require some additional software 'patching' in order to provide Z80 simulation . . . not a very agreeable thought.

An operating system often includes provision for entering programs in Hex machine code by means of a Machine Code Monitor. Many of these are lacking in editing facilities of any real worth. Not many people attempt to use machine code, not only because it is difficult but because the machine code monitor is so unfriendly and allows programs to crash on the slightest provocation. Those intending to capitalise on the quite enormous superiority of machine code in terms of execution speed and memory efficiency would be well advised to either buy an 'Assembler' or choose a machine which has one resident in ROM. An assembler is a chunk of software which takes a great deal of the aggro out of machine code writing, allowing among other things, the ability to use mnemonics for the Op Codes instead of the almost meaningless Hex symbols. In addition, a good assembler will provide excellent editing facilities and allow jump destinations to be labelled instead of the error-prone byte-counting inherent in raw machine code. The use of user-chosen symbolic operands instead of absolute addresses is another valuable feature.

The Microprocessor

If you open up the innards of any microcomputer you will probably expose a large circuit board crammed with black rectangles which are the silicon integrated circuits (chips). One of the larger rectangles with no special markings on it, other than the usual batch of code numbers stamped on the back, will be the microprocessor. It is the most complex, hard-working chip on the board and is taken for granted by most of us who program in BASIC or indeed any high-level language. The other chips on the board do have spells of inactivity during the periods when they are not required but the poor microprocessor never has time to get its feet up. If the power is on, even though there may be no-one at the keyboard, it is rushing around supervising the entire system, checking the keyboard and the display area about 50 or more times a second and doing dozens of other mundane but highly important jobs. And yet this demure little device is hardly ever considered when choosing a machine: some manufacturers don't even trouble to mention what type of microprocessor is inside. The reason of course is that most programs are written in high-level language and there is consequently a mass of translation software between you and the microprocessor, protecting you from all this complexity. For example, when you write FOR X = 1 TO 20 the software in ROM will have to change this into probably as many as 50 machine code instructions in the language the microprocesor will understand.

If you intend to program in machine code (or assembly code) be warned that the microprocessor will now be less demure. You will have to fight the monster in its own language . . . and this language differs in microprocessors of different types! There are many different microprocessors on the market and new ones are springing up monthly but in the case of the more 'popular' machines you may expect to find either a Z80 or a 6502. The Z80 is the more 'powerful' of the two although power is not an easy quality to measure since so many imprecise factors (including subjective) are involved. Familiarity is one of these and may prejudice judgement. Thus if you have been brought up on the 6502, you may find the Z80 a shocking mix-up . . . and vice versa. They are both eight-bit micros, meaning that all transactions between memory and microprocessor are in blocks of eight binary bits. Because of the limit on the highest binary number (255 in pure binary or ±127 in two's complement) which can be squeezed into eight bits, numbers encountered in the real world can only be manipulated by stringing together four or five blocks. This is done automatically in high level language. The next generation of micros (some being here already) may be using 16 or even 32 bits which will enable higher speed and perhaps more convenient machine code operations. With regard to speed, this ultimately depends on the highest allowable clock frequency which a given microprocessor can handle, between 1 and 4 MHz being the typical range at the moment. For those having no intentions of ever using machine code, the type of microprocessor in the machine is not very important . . . you are hardly aware of it anyway!

Because of the cheapness of microprocessors, some machines already use more than one microprocessor. This is called 'Distributed Processing' in the sense that the total processing power, instead of being under the responsibility of one microprocessor, is shared by two or more. One of them is still the boss, the others will be comparatively under-used and may, for example, be charged only with the task of handling the input and output of data. The net result is a considerable increase in efficiency. For instance, a Z80 may be used as the boss and a 6502 for input and output and there may be yet a third reserved for disc control uses and even a fourth for the printer. It is disturbing in a way that the microprocessor, originally heralded as a 'miracle chip' has, in the course of a mere 10 years, been downgraded to the humble status of a mere 'component', sharing its humbleness with peasants like the resistor or capacitor.

Appearance

It is impossible to ignore the effect of appearance on a potential purchaser of a microcomputer. A nice glossy looking case with beautifully coloured keys can sell on sight alone, particularly if you are an impulse buyer. Alaz, the cliché 'all that glitters . . .' applies equally to computers. It is possible for a manufacturer to spend a disproportionate amount on the case at the expense of the intestines. In contrast, one of the many excellent 'board' computers (which is supplied just as a bare circuit board) may look unattractive but screwed into even a home-built case can outperform its glamorous rivals.

Be warned, however, that although your home-built, home-cased machine may well out-perform all comers it is unlikely to have much commercial value as a 'trade-in' when you expand.

On-board Extras

Most microcomputers will be supplied (as standard) with a cassette tape interface, a UHF modulator for the TV display and some form of input/output port into which you can plug various gadgets (if you know how to connect them). There will also be another 'standardised bus' for connecting commercial peripheral devices, printers, floppy discs, etc. This is a bewildering area for the newcomer because of the confusing number of these standard buses. The subject is too complex to treat here except to mention that, in the case of printers, the two popular choices are either the RS232 (which is a serial interface, meaning that the eight bits for a character are passed along one wire, one bit at a time) or the 'Centronics' interface in which all 8 bits are fed at once (parallel). It is courteous to mention that Centronics is a firm's trademark and their printers have been accepted as a kind of standard.

Very few popular machines offer analogue to digital conversion circuitry as an on-board feature. Those that do should be given more than a second glance because if your interests lie in the direction of controlling external devices, other than the customary data processing peripherals, you will find it is more costly to buy A/D converting channels afterwards. In the real world, quantities such as temperature, acceleration, velocity are analogue in nature. They vary smoothly through a given range rather than in discrete steps. A digital computer, however, can only respond to binary bits which are essentially yes/no signals. If the physical quantities are converted into voltages proportionally to them (which is easy) and then converted into binary blocks (which isn't quite so easy) the computer can, as it were, be on line to the real world opening up an exciting range of new activities. A typical A/D module will contain not only the circuitry for the actual conversion of voltages but facilities for selecting one of many different voltage lines. Thus a 'four-channel' converter implies that four separate voltage sources can be connected and any one chosen at any time under program control. We could, for example, envisage a computer being fed with information on temperature, humidity, air-pressure and wind velocity and after due deliberation, responding accordingly.

Another extra which may be provided is a 'light-pen' interface, enabling you to input information by just pointing the pen at the desired area of the display. Small loudspeakers, plus amplifiers, plus software may be present with facilities for playing tunes or creating special sound effects. All these extras must be taken into account when assessing the value of a machine . . . they would cost much more to buy separately than the increased cost of initial provision.

Expansion

Whichever machine you buy there will come a time when, in the light of experience, the existing facilities will be inadequate.

To exchange the model for a new one will represent a considerable cash loss so it is desirable for economic reasons that you buy with future expansion in mind. The expansion may take the form of increased RAM, superior backing store (floppy disc instead of cassette tape or Winchester instead of floppy disc) or perhaps an update in the operating system. An increase in RAM is the most frequent kind of expansion and machines which provide empty sockets for extra RAM chips are an attractive proposition. There are other machines, however, which allow spaces on the board for extra RAM but arranged in a manner which discourages the 'man in the street' from attempting the expansion. This might take several forms such as ensuring the soldering task is difficult and not supplying the small decoupling capacitors required on the power supply pin. There may also be a requirement for fiddling with jumper wires which, to someone unskilled in reading electronic diagrams, could present a frightening prospect. The RAM chips themselves are surprisingly cheap nowadays but beware of the bargain sets, they may be untested or low-spec versions.

It was mentioned earlier that microprocessors with 16 pins on the address bus cannot *directly* address more than 64K of memory. It is possible, however, to increase this without limit by employing some form of memory selection. A separate block of, say, 64K can be switched in (exchanged) either by simple manual methods or by crafty electronic dodges providing you are willing to put up with a few time penalties. RAM chips come in various forms but perhaps the most popular in small computers is the 4116 which is a 16K x 1, meaning it can store 16K words each of only *one* bit. To preserve the eight-bit architecture, you require a bank of eight 4116 chips to form a 16K x 8 memory system. This is an exciting time for those with a lust for enormous RAM. Several firms are now producing 64K RAMs and even the 256K RAM is almost here. After the dust has settled, we may be entering an era of home computing in which much larger memories will be supplied in basic models. Perhaps in the near future we shall hear remarks like 'however did you manage in the old days with just 32K?'

Support

The status of a firm's name and the popularity of its models is a factor which cannot be ignored when choosing a machine. It is so easy to purchase a particular make which has excellent qualities but is not well supported. There are two kinds of support. A firm may offer quite good guarantee periods and respond in a helpful and gentlemanly manner to its customers. It may also be sound financially. From the point of view of the home computer type, support has an additional meaning . . . is the machine frequently mentioned in magazines, together with example programs? If your machine is barely mentioned you may feel a little in the wilderness and may like exchanging it, perhaps even for an inferior one, in order to be one of a group. This attitude is a pity, particularly for many small firms who market an excellent product, but it is a fact of life. It is because of this that a handful of firms dominate the market, not entirely due to the technical merits of their machines.

Software support is also a major factor. Not everyone has the ability or the time to write their own programs and they rely exclusively on buying or keying in other people's programs. As far as the small businessman is concerned software support is probably the overriding consideration.

When To Buy

It is doubtful if it is ever the right time to buy. New machines or upgraded models of existing ones are appearing almost overnight. You will buy and a few months later kick yourself, not necessarily because of dissatisfaction with it but because a superior model for the same money has just appeared.

The Future

Although it was initially stated that particular products would not be discussed, it would be cowardly not to make a few comments on the BBC Computer which is due to be released in the last quarter of '81.

There seems to be a certain amount of hostility towards this project. If we were to take seriously the sarcasm and abuse directed (in advance) by some writers in the technical press, the poor thing would be in danger of strangulation before birth. The main cause of annoyance is probably due to the almost unbelievable specification coupled with the almost unbelievable price of about £230 (£330 for the enhanced version). If we accept the specification as written in the advanced literature, it is going to cause a few red faces amongst the popular manufacturers . . . including the Japanese! The main criticism appears to be that it might not be ready in time for the series of programmes starting on January 10th 1982 on the BBC 1 channel. With a specification that includes an enhanced BASIC (see June's issue) with powerful extras, high (in fact very high) resolution graphics, full colour, on-board A/D conversion with four channels, two printer interfaces, loudspeakers, 32K of RAM and 32K of ROM expandable to 43K, a resident assembler, UHF modulator and direct monitor facilities, standard keyboard plus six keys which are user-definable, it wouldn't matter to me if it was a few weeks (or even months) late. In any case, the BBC programmes are *not* absolutely dependent on it . . . although it would naturally be a great advantage for hands-on experience.

Another expansion option is a Teletext decoder which will enable software to be loaded directly into your machine via the television.

Let us hope that Acorn, the company who won the right to produce it, can get it made in sufficient quantities to meet what will probably be the most rapacious demand ever experienced for a personal computer in this country.

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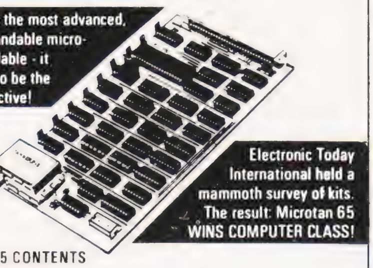

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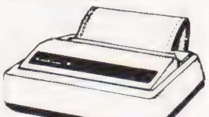

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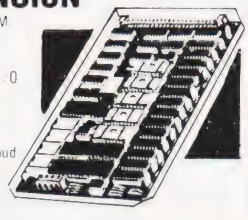

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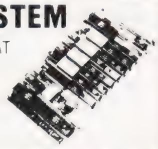

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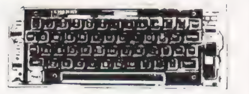

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FOX AND HEN

M P Biddell

Learn logic with this entertaining program on the ZX80

In the wake of Margaret Thatcher's announcement that financial aid would be provided to equip all secondary schools with a micro, I decided to dabble with production of a logic gate trainer for the ever popular (and recently scrapped!) ZX80 with 3K or 16K expansion. The program will, however, run on the ZX81, having analysed the functions in the new ROM, without modification. Many schools will opt for the ZX81 on the basis of performance and cost, and many schools already have ZX80s. The program can easily be converted to run on other micros used by schools since it avoids using special ZX80 BASIC features.

The program allows a discovery learning process in which students open and close the gates of six cages, to determine whether a fox can gain access to a hen and eat it. The knowledge gained from this visual and manual experimentation is applicable to all switching circuitry and all logic problems involving AND and OR gates. It makes the learning process more interactive using the computer. In fact, it's an ideal application of a micro to assist the learning process.

Using The Program

The program should be started using GOTO 90. This produces the VDU display shown in Fig. 1, which represents a plan view of six cages. 'F' represents the fox and 'H' represents the hen. The letters A to G represent the gates to the cages. In response to the question 'is gate A open 1=yes 0=no?' the student simply presses 1 or 0 followed by NEWLINE. Pressing 0 will block gate A with a black square, thus closing it. The student is then confronted by a similar question for gate B and so on. When all the gates have been programmed to be open or closed the computer makes the quite complex decision as to whether the fox can eat the hen or not. This is obvious visually, since if a combination of gates is open to allow the fox to wander through to the hen, he could eat it. If access to the hen is allowed, the fox (F) will be POKEd into the hen's cage and the hen (H) will disappear. Pressing 'R' resets the gates.

Learning By Discovery

The student is asked to examine line 440 of the program:

```
IF A AND B AND E = 1 OR C AND F AND G = 1
OR A AND D AND G = 1 OR C AND F AND D
AND B AND E = 1 THEN GOTO 470
```

This single line is the computer's controlling logic for this complex decision (there are many many combinations of gates). The student is asked to test as many combinations of gates as he can think of to indeed verify that this controlling logic is correct for all the combinations. Without being aware of it the user is learning, by this simulation, the basic principles of switching and logic circuitry. This is quite a fun way of learning.

The Program Structure

The program overcomes the ZX80 memory mapping problem by accessing the address of the D-file through PEEKing system variables 16396 and 16397 and using these to define variable W. See line 150 of the program. The gates to the cages and the fox (F) and hen (H) are then POKEd into the D-file using variable W, plus a displacement, lines 160-240 carry this out. The gates are closed by POKEing CHR$(128) into the D-file (lines 360-420).

Line 440 represents the decision-making logic for the fox to eat the hen (or otherwise). If the fox is able to eat the hen lines 475 and 476 POKE the appropriate positions to move the fox and make the hen disappear.

The Future

Programmers have concentrated, in the past, on writing games. In the educational sphere, applications have been very limited. There is a great scope for programs that simulate physical systems very closely and allow students to 'play tunes' with certain variables to see how the system would react. I believe this is the direction in which we should be progressing, since micros are very adept at quickly computing/processing large numbers of combinations and displaying the results.

A variety of analogue and digital systems could be simulated and the student could indulge in many experiments of the type, 'what happens if I?', with the micro showing the results visually.

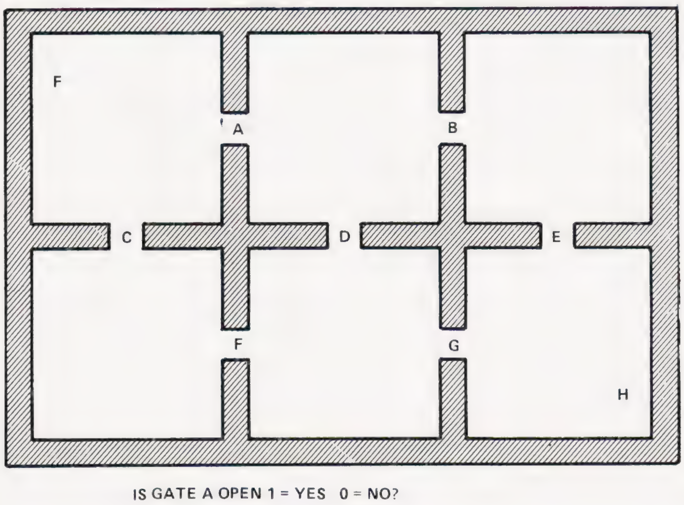

Fig.1. The screen format.

Program Listing

```
1Ø   FOR J=1 TO 24
2Ø   PRINT CHR$(128);
3Ø   NEXT J
4Ø   RETURN
5Ø   FOR I=Ø TO 16
6Ø   PRINT CHR$(128),
7Ø   NEXT I
8Ø   RETURN
9Ø   CLS
91   PRINT "FOX AND HEN"
92   LET B=1
93   LET C=1
94   LET D=1
95   LET E=1
96   LET F=1
97   LET G=1
1ØØ  GOSUB 1Ø
11Ø  GOSUB 5Ø
12Ø  GOSUB 1Ø
```

```
130  GOSUB 5Ø
135  PRINT CHR$(128);
14Ø  GOSUB 1Ø
15Ø  LET W=PEEK(16396)+PEEK(16397)*256
16Ø  POKE W+82,43
17Ø  POKE W+87,38
18Ø  POKE W+252,43
19Ø  POKE W+95,39
2ØØ  POKE W+26Ø,44
21Ø  POKE W+182,4Ø
22Ø  POKE W+19Ø,41
23Ø  POKE W+198,42
24Ø  POKE W+264,45
241  PRINT
245  LET Z=37
246  LET Z=Z+1
247  IF Z=45 THEN GOTO 44Ø
25Ø  PRINT"IS GATE ";CHR$(Z);" OPEN? 1=YES Ø=NO"
26Ø  INPUT X
28Ø  IF Z=38 THEN LET A=X
29Ø  IF Z=39 THEN LET B=X
3ØØ  IF Z=4Ø THEN LET C=X
31Ø  IF Z=41 THEN LET D=X
32Ø  IF Z=42 THEN LET E=X
33Ø  IF Z=43 THEN LET F=X
34Ø  IF Z=44 THEN LET G=X
35Ø  IF A=Ø THEN POKE W+86,128
37Ø  IF B=Ø THEN POKE W+94,128
38Ø  IF C=Ø THEN POKE W+149,128
39Ø  IF D=Ø THEN POKE W+157,128
4ØØ  IF E=Ø THEN POKE W+165,128
41Ø  IF F=Ø THEN POKE W+251,128
42Ø  IF G=Ø THEN POKE W+259,128
43Ø  GOTO 246
44Ø  IF A AND B AND E=1 OR C AND F AND G=1 OR
     A AND D AND G=1 OR C AND F AND B AND E=1
     THEN GOTO 47Ø
45Ø  PRINT"HEN IS SAFE"
46Ø  GOTO 48Ø
47Ø  PRINT"FOX ATE THE HEN"
475  POKE W+82,Ø
476  POKE W+264,43
48Ø  PRINT"PRESS R FOR RESET"
49Ø  INPUT A$
5ØØ  IF A$="R" THEN GOTO 9Ø
51Ø  GOTO 49Ø
```

FIGURE FORMAT

John Hiscott

Cleaning up your decimal points for neater output on Triton

Extended scientific BASIC interpreters very often have no built-in facility to enable figure-formatting which results in amounts being displayed left-justified without leading or trailing zeros. For accounting routines amounts should be displayed right-justified showing two-decimal precision with trailing zeros and zero before the decimal point where appropriate. Such output provides correctly aligned pound, decimal point and pence columns. The subroutine described and listed here comprises two sections which:

(a) format and display the value of variable 'X' and
(b) Display trailing '+' or '−' signs as required.

Entering The Subroutine

Immediately before the variable 'X' is to be printed, the instruction 'GOSUB 1000' is inserted which calls the subroutine. The line-numbering is arbitrary and intended to place the subroutines after the main program listing (which should be terminated by a 'STOP' or 'GOTO' instruction as required).

```
1000  IF X=0 THEN Y$="0.00":GOTO 1003
1001  Y=X:Y=INT(Y*100+(SGN(Y)/2))/100
1002  GOSUB 1006
1003  PRINT TAB(T-LEN(Y$));Y$;
1004  GOSUB 1014
1005  RETURN
1006  Y=ABS(Y)
1007  Y$=STR$(Y)
1008  Y$=MID$(Y$,1,LEN(Y$)-1)
1009  IF MID$(RIGHT$(Y$,4),1,1)="E"
      THEN Y$=".0"+LEFT$(Y$,1)
1010  IF Y<1 THEN Y$="0"+Y$
1011  IF MID$(RIGHT$(Y$,3),1,1)="." THEN
      RETURN
1012  IF MID$(RIGHT$(Y$,2),1,1)="." THEN
      Y$=Y$+"0":RETURN
1013  Y$+Y$+".00":RETURN
1014  IF X<0 THEN PRINT "−"
1015  IF X>0 THEN PRINT "+"
1016  IF X=0 THEN PRINT
1017  RETURN
```

Explanatory Notes

This subroutine is written specifically for disc BASIC-E on the Triton but the following comments should assist in adaptation for other extended floating-point BASICs. Line functions are described in order of program flow.

Line 1000 produces the correct display format if the value of 'X' is zero and then returns to the print routine.

Line 1001 assigns the value of 'X' to 'Y' for subsequent operations and rounds the value of 'Y' to two decimal places.

Lines 1006/7 changes 'Y' to its absolute value and then to a 'string' variable.

Line 1008 removes the space appended to numeric values by BASIC-E.

Line 1009 tests for scientific notation and if necessary adds a leading decimal zero to the first (significant) figure. This operation is necessary because values of less than .1 are normally displayed in scientific notation.

Line 1010 adds a leading (pound) zero to amounts of less than 1.

Line 1011 tests for a decimal point in the third position from right. If present, the format is correct and the subroutine terminates.

Line 1012 tests for a decimal point in the second position from right. If present, the format is incorrect and a trailing zero is added. The subroutine then terminates.

Line 1013 adds a decimal point and two zeros to the whole (pound) amounts. The subroutine then terminates. After returning, line 1003 prints the value of Y$ (=X) in corrected format. Note that the variable 'T' must have previously been assigned a value which will determine tabulation of the right-hand character of the amount (right justification). The line ends with a semi-colon which suppresses the line-feed and carriage-return in readiness for the subroutine at lines 1014-6 which adds the appropriate sign to the displayed value. The value of the variable 'X' remains unchanged for further processing as required.

Conclusions

Although an apparently lengthy routine, the extra processing time involved is almost undetectable, even when reading and displaying values from diskette. The result is neat and easy to read and more than justifies the small additional time and space involved. The short example below shows the operation of this program.

Normal Display	Corrected Display
0	0.00
1.00000E-02	0.01 +
1	1.00 +
1.1	1.10 +
10	10.00 +
−100	100.00 −

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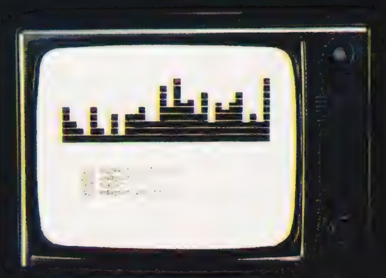

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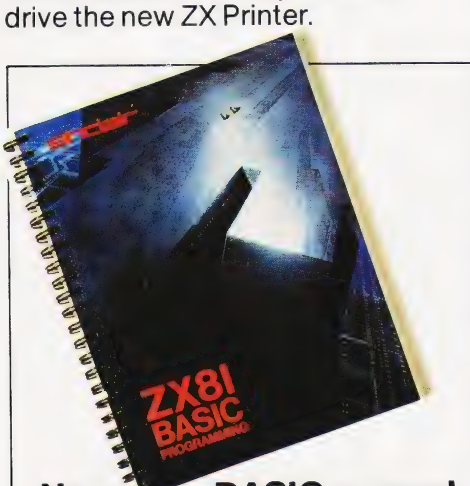

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How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC FUNCTIONS	ABS, RND	●	●	●	●	●	●	●
	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING FUNCTIONS	CHR$	●	●		●	●		●
	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm10^{\pm38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC VARIABLES	A-Z			●			●	
	AA-Z0				●	●		●
	An-Zn, n=any alphanumeric string	●	●					
STRING VARIABLES	A$ & B$						●	
	A$ to Z$	●	●	●				
	An$ to Zn$ n=any alphanumeric character				●	●		●
NUMERIC ARRAYS	SINGLE DIMENSIONAL		●	●			●	
	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL FEATURES	USR (CALL, LINK)	●	●	●	●	●		●
	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

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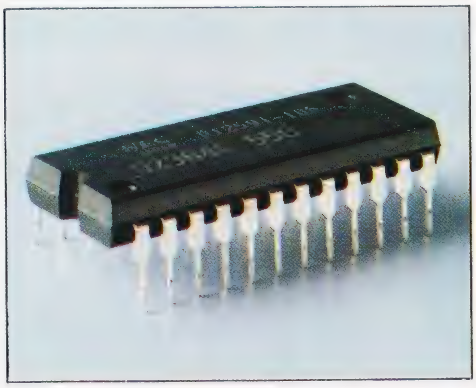

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BASIC UPGRADE

Paul Kriwaczek

Adding your own structures to BASIC has been made easier by one enterprising firm. We show you the way it's done

In the last year, the magazines and even the daily papers have been full of articles and letters about the benefits or otherwise of structured programming. Professor This has written to say that the advent of BASIC has put computing back to the age of Babbage, while Senior Lecturer That is terribly worried about the bad habits to which it apparently inevitably leads and then Mr The Other pleads that the democracy inherent in BASIC is computing's answer to Che Guevara.

It isn't my intention to open the boring debate yet again, because people who actually program computers, as opposed to those who only teach and preach about them, will do as people have always done and use whatever tools come most conveniently to hand. For some simple routines machine code will be most suitable, for others it will be assembly language; BASIC will be used for relatively short and self-contained programs, and Pascal resorted to for systems work and applications where reliability and maintainability are at a premium; and Ada, I suppose, will be used to find the answer to Life, the Universe and Everything.

Self Enhancement?

But, while the different languages do have different features and facilities, there is no reason why one kind of code can't take a lesson from another. Somebody who has been put off the structured languages by the monotonic chants of the computer Gurus and believes that anything that is supposed to be so good for them must necessarily be pretty unpleasant, might actually find it more convenient to be able to write, for example:

```
10 REPEAT
15
20 (block of code)
25
30 UNTIL X>100
```

than the tangled knot of IF . . . THENs and GOTOs which BASIC normally displays. There are in fact some BASICS now being marketed which support these Pascal-like structures, without going so far as to call the language by another name. But if you don't have a machine for which one of these new fancy interpreters has been written then there is nothing you can do about it, is there? All you can do is to go on using your faithful 8K Microsoft in the same old way. Right?

Wrong! All you need to change all that is a form of BASIC that resides in RAM rather than ROM, a superficial understanding of how the interpreter uses your source program and a limited familiarity with the machine or assembly code of your processor.

Good accounts for the workings of the firmware have been published for the PET and for the TRS80. But, for owners of NASCOMs and the Sharp MZ80K, the whole thing has been made much easier by Crystal Electronics of Torquay, Devon, who not only market an interesting and unusual BASIC interpreter, but also have the courtesy and generosity, unusual for a software house, to publish an explanation of how it works together with the addresses of its most important and useful routines.

Armed with Xtal BASIC on tape and what they, not I, call 'The Hack's Guide to the Innards of Xtal Basic 2.2', it is now actually possible for your average amateur computerist to incorporate whatever structures are most useful, as if they had always been there; and the purpose of this article is to suggest that you don't have to be a systems software whizz-kid to do it. The code is actually easier to write than a lot of the games which we don't think twice about having a go at.

When you enter your ingenious program, what most BASIC interpreters do is not to store all the reserved words in full, but to store them in the form of single-byte tokens, usually with the top bit set for easy recognition. This not only saves space but makes execution faster, since it is obviously easier to pick a single byte out of a look-up table than to have to match words painstakingly, letter for letter. Xtal BASIC acts in this way too, but with an additional feature: as well as the regular list of reserved words, there is a space for the table of user-defined keywords, and a parallel table for the addresses of the routines to handle the new commands and statements.

These user-defined reserved words are also converted to single-byte tokens with top bit set, but this time they are always prefixed in the source code by a byte of FF Hex, so that they can be easily recognised.

Doing It By The Book

To judge by the user's handbook, this facility is mainly used to incorporate new functions like Hyperbolic Arctangents and other arcana, but there is no reason why the new keywords should not be used to alter the flow of control in the program.

To do this, you only need to know a few simple facts. As it wanders about the byways of your version of 'Galaxy Marauders', the Xtal interpreter keeps its 'bookmark', the text pointer to its place in the source code, in the HL register of the Z80. When it calls your new subroutine, all you need to do to send it on the scenic route around your new structure is to alter the contents of HL appropriately and RETURN from the subroutine. The only other things you need to know are the addresses for a few of Xtal's own routines like EXPR and CHKSGN. These two, when called one after the other, evaluate any expression pointed to by the HL registers, and return zero in the Accumulator and Zero Flag set if the expression evaluates to untrue.

Knowing all this, let us see how one can implement the REPEAT...UNTIL structure in the example above.

What does REPEAT . . . UNTIL actually do? REPEAT, in fact, does nothing except define the beginning of the loop. When execution of the program reaches UNTIL a test is performed on the following expression and if it fails, we loop back to the keyword REPEAT and do it all over again. If the UNTIL test succeeds we simply continue through the program as if nothing had happened.

So, how can we build this structure into the BASIC? The easiest way to do this is to stack the text pointer whenever the interpreter comes across the keyword REPEAT and retrieve it again if the test after the next UNTIL statement fails. As we are not sure what the Xtal stack is up to at any particular time, it is safer to set up our own loop stack for this purpose and to keep an address LOOPSP to store the pointer when it's not in use as well as another, OLDSP, for Xtal's stack pointer. There is a gap in Xtal's workspace from 0E00 to 0E80 (Hex) which is ideally suited for a new stack with a few useful storage locations on top.

As it comes on tape, Xtal BASIC occupies up to 2D00 Hex on the Nascom but by altering the pointer to the beginning of the program area in HTEXT (1283 Hex) to 3000, we can keep the space from 2D00 to 3000 Hex for our new routines. So, we assemble them from 2D00 Hex upwards.

```
REPEAT,LD (OLDSP),SP     Store Xtal's stack pointer
       LD SP,(LOOPSP)    Load loop-stack pointer
       PUSH HL           Save current text pointer
       LD (LOOPSP),SP    Store new stack pointer
       LD SP,(OLDSP)     Replace Xtal's stack pointer
       RET

 UNTIL,CALL EXPR
       CALL CHKSGN       Test expression
       JR NZ CONT        If test succeeds don't go back
       LD, (OLDSP),SP
       LD SP, (LOOPSP)   otherwise
       POP HL            get back old text pointer
       PUSH HL           Don't forget to replace
       LD (LOOPSP), SP   address on stack
       LD SP, (OLDSP)
       RET
  CONT,PUSH HL
       LD HL, LOOPSP     We are going on
       INC (HL)          so we can
       INC (HL)          throw away top of stack
       POP HL
       RET
```

Now we put the new reserved words in the auxiliary keyword table from 0E80 Hex:

```
0E80 D2 45 50 45 41 54 REPEAT
0E86 D5 4E 54 49 4C    UNTIL
```

with the first letter's top bit set, and the new addresses into the auxiliary address table from 0F80 Hex:

```
0F80 00
0F81 2D
0F82 13
0F83 2D
```

'And,' as Brucie used to say in The Generation Game, 'That's all there is to it!' You can now use REPEAT . . . UNTIL as part of any Xtal BASIC program.

While We're At It

Buoyed up with confidence after REPEAT . . . UNTIL, the next step is to try WHILE . . . ENDWHILE.

The difference between this kind of loop and the last is that REPEAT is tested at the *end* of the loop and WHILE at the *beginning*. This makes the job of constructing it a little bit more difficult because we must ensure that the address we store is for the beginning of the line which starts with WHILE rather than the end, so that the condition gets tested on every trip round the loop. Luckily Xtal stores the address of the beginning of every line before it processes it, so the whole routine is still no more than a few lines of code.

The first problem is, in fact, a rather trivial one: what should the closing keyword be? ENDWHILE can't be used because END is already a reserved word and the same goes for WHILEND which starts with WHILE. I finally settled for WEND, which has a nice antique flavour to it and is actually used in some forms of structured BASIC.

So what happens when we call WHILE? If the test at the beginning of the loop succeeds, the text pointer is pushed onto the loop-stack ready for the next time round. If it fails, however, Xtal BASIC goes rushing off up the program looking for the keyword WEND at which point to take up executing the program again. But hold on, there is another slight problem here. Consider the following fragment of code:

```
10 WHILE X< 100
20   WHILE N = 1
30     PRINT "Hello"
40   WEND
50   PRINT "Goodbye"
60 WEND
```

If X starts off greater than 100, the test in line 10 fails and BASIC will go off like a bloodhound looking for the keyword WEND. The first one it will find is the one in line 40, but it's the wrong one; that one matches the WHILE in line 20. Our routine has to understand that WHILE and WEND always come in pairs and that if it comes upon another WHILE in its search for a WEND, it must give that WEND a miss and carry on until it finds the next one.

The easiest way to do this is to set up a counter which we can call WHLCNT and keep somewhere convenient like near the top of the loop-stack. This counter is clocked up by 1 for every WHILE the routine finds and is clocked down for every WEND. When the counter decrements to 0 we know we have found the matching WEND.

But how do we examine successive lines for the keyword WEND? Xtal BASIC stores its lines in the following way: the first two bytes contain a 16 bit pointer to the beginning of the next line: then there are 16 bits for the line number expressed in Hex, then the text of the line itself with all the reserved words encoded into tokens and finally a null byte to mark the end of the line. The user defined keywords are all preceded by a byte of FF Hex, and if the syntax is correct, they must appear at the beginning of a BASIC line, or after a colon in a multi-statement line. So what we need is a routine which will return the sixth byte from the beginning of a line or the second after a colon, at the same time as making sure that if the matching keyword is not found, we jump to an error routine rather than trying to execute as BASIC whatever happens to lie on top of the source code in memory.

```
NEXLIN,INC HL            Routine to find end of statement
       LD A, (HL)        Load the next character
       CP 3AH            Is it a colon?
       JR Z RET1         If so go to appropriate exit point
       OR A              Is it zero?
       JR NZ NEXLIN      If not, try next character
       LD DE, 06
       ADD HL,DE
       PUSH HL
       LD BC, (OCB7H)    This is Xtal's end of program pointer
       AND A             Is address in HL higher
       SBC HL, BC        than the end of program?
       POP HL            If so,
       JP P ERROR        jump to error routine
       RET
  RET1,INC HL
       RET
```

Xtal has a routine to tell you what the token for any particular keyword is, but in any case they go up consecutively from 80 Hex. (Top bit is set, remember?) So if we have implemented REPEAT, UNTIL and WHILE, the token for WEND must be 83 Hex.

```
 WHILE,PUSH HL
       LD (OLDSP),SP
       LD SP,(LOOPSP)
       LD HL,(OCAFH)     Xtal has saved the text pointer here
                         at the start of the statement
       PUSH HL           Save pointer to start of line
       LD (LOOPSP),SP
       LD SP, (OLDSP)
       POP HL
       CALL EXPR
       CALL CHKSGN       Perform test. If it fails
       JR Z ENDWHL       go looking for WEND
       RET
ENDWHL,LD A,(WHLCNT)     This is the counter
       INC A             We've found 1 WHILE so clock up
       LD (WHLCNT),A     Save counter
  SEEK,CALL NEXLIN + 1
       LD A, (HL)
       CP 82H            Is token WHILE?
       JR NZ ISEND       If not, try WEND
       PUSH AF
       LD A, (WHLCNT)
       INC A             Clock up another WHILE
       LD (WHLCNT),A
       POP AF
 ISEND,CP 83H            Is token WEND?
       JR NZ SEEK        If not, go back and try again
       LD A, (WHLCNT)    We've found a WEND so
       DEC A             decrement counter
       JR NZ SEEK
       PUSH HL
       LD HL,LOOPSP      We've found the right WEND
       INC (HL)          so throw away
       INC (HL)          top of stack
       POP HL
       INC HL
       RET
```

And again we place the keywords, with the top bit of the first letter set, in the auxiliary keyword table and the matching addresses in the auxiliary address table.

Structuring On The Cheap

A third structure which is particularly useful in any BASIC interpreter is an expanded form of IF . . . THEN . . . ELSE. This should allow a number of lines to be executed in the following way:

```
10 IF X = 10
20
30 (Block of code)
40
50 ELSE
60
70 (Block of code)
80
90 ENDIF
```

Once again, we have a problem with ENDIF and in tune with the antiquity of the word WEND, I chose FEND for the terminator to this structure. Let's just see what happens when the interpreter comes across this in the code.

Suppose that X does equal 10. The program will then continue until the word ELSE is encountered. At this point, the interpreter goes off to look for the keyword FEND from which point to continue. This is hardly different from what we have just achieved with the WHILE construction. If, however, X does not equal 10 when this block of code is encountered, the program will want to

start from the word ELSE and when it encounters FEND, it will take no notice.

In one way this routine is simpler than the last, in that there is no looping to allow for. But on the other hand there is the possibility of nesting in two different places: between the IF and the ELSE and between the ELSE and the FEND. If we want to allow for single line IF . . . THEN statements in addition, we must ensure that the IF is not clocked up when the expression to be tested is immediately followed by the keyword THEN. To do this, we use another Xtal routine IGLBLK at 16DB Hex, which scans the text for the next non-blank character, EXPR to move the text pointer past the end of the expression and another nest-counter IFCNT, stored near the top of the loop stack.

A slight additional complication is that IF already exists as a Xtal reserved word and has its own routine to cope with THEN (line number), THEN GOTO, THEN GOSUB or THEN (statement). The 'Hack's Guide' tells us that Xtal's IF routine starts at 1953 Hex and closer examination shows that 195B Hex is a convenient place at which to divert the original routine to the new one if the statement to be tested is not immediately followed by THEN. So at 195B Hex we write:

```
CP A5H         Is the next character THEN?
JP NZ NEWIF    If not, jump to new routine
```

Here is what the routine might look like:

```
 NEWIF,CALL CHKSGN    Test expression. If test succeeds
       JR Z NOTIF     go on. If it fails, return
       RET
 NOTIF,LD A, (IFCNT)
       INC A          Clock up 1 IF found
       LD (IFCNT),A
  LOOK,CALL NEXLIN + 1  Find start of next line
       LD A,(HL)      Is this character
       CP 84H         the token for IF?
       JR NZ IFNOT    If not, look for ELSE
       CALL THEN      Is it a single-line IF . . . THEN?
       JR Z LOOK      If so, don't clock it up
       PUSH AF
       LD A, (IFCNT)
       INC A          Clock counter up by 1
       LD (IFCNT),A
       POP AF
       JR LOOK        Go for next line
 IFNOT,CP 85H         Is this a token for ELSE?
       JR NZ LOOK     If not, go for next line
       LD A,(IFCNT)
       DEC A          Decrement counter by 1
       LD,(IFCNT),A   If it decrements to zero
       JR Z GOTELS    we have found matching ELSE
       JR LOOK        Go for next line
GOTELS,INC HL
       RET
  ELSE,LD A,(IFCNT)   First ELSE found so
       INC A          clock up counter
       LD (IFCNT),A
  SEEK,CALL NEXLIN - 1  Get character from start of next line
       LD A,(HL)
       CP 84H         Is it the token for IF?
       JR NZ ISFEN    If not, try FEND
       CALL THEN      Is it a single-line IF . . . THEN?
       JR Z SEEK      If so, don't count it
       PUSH AF
       LD A,(IFCNT)
       INC A          Clock up counter by 1
       LD (IFCNT),A
       POP AF
       JR SEEK        Try next line
 ISFEN,CP 86H         Is it the token for FEND?
       JR NZ SEEK     If not, look again
       LD A,(IFCNT)
       DEC A          Decrement counter by 1
       LD (IFCNT),A   If counter is not zero
       JR NZ SEEK     go on looking
       INC HL
       RET
  THEN,PUSH HL        Use Xtal routine to find
       CALL IGLBLK    the next non-space character
       CALL EXPR      Move pointer on past expression
       LD A,(HL)
       CP 89H         Is it the token for GOTO?
       JR Z END       If so, it is single line
       CP A5H         Is this the token for THEN?
   END,POP HL         Return with flags showing
  FEND,RET
```

The Last Steps

Only one final stage remains before we have three sound new working structures. Like any routines which make use of a stack, we must allow for disasters. Should the program stop execution in the middle because of an error of some kind, we have to make sure that we don't leave garbage on the stack uncleared, or worse, that we don't then pop more bytes than we PUSH, otherwise the stack may gnaw its way into vital memory areas. We also have to arrange that when our routines are called for the first time the contents of LOOPSP, the loop-stack pointer storage location, are set up correctly. We learned to send Xtal's original routines on a tour of our own diversions at the beginning of the IF . . . THEN statement, so we do it once more now. By changing the contents of 1812 Hex to: JP INIT, every time RUN is called, control first passes to a new INIT routine which clears all the counters and sets up the stack pointer.

```
 INIT,PUSH HL, DE, BC, AF
      LD DE,0E7AH
      LD HL,TABLE
      LD BC,06
      LDIR
      POP AF, BC, DE,  HL
      JP Z 1416H     The jump in Xtal's RUN routine which we
                     replaced with the jump to INIT
      JP 1815H       Jump back to Xtal's RUN
TABLE,7AH 0EH 00 00 00  00
```

As I said earlier, the purpose of this article is not so much to present finished routines which can be copied and used — I make no claims for their elegance or economy — but to suggest that altering sections of a BASIC interpreter is nothing like as daunting a task as it may seem at the outset. And you don't even have to have an assembler to do it. I assembled all of the above code by hand, pencil and paper. No, not because I'm a masochist, but because my assembler and Xtal BASIC fight over part of the same workspace; and it was only after hours of Syntax Errors and system crashes that I realised it!

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SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

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TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

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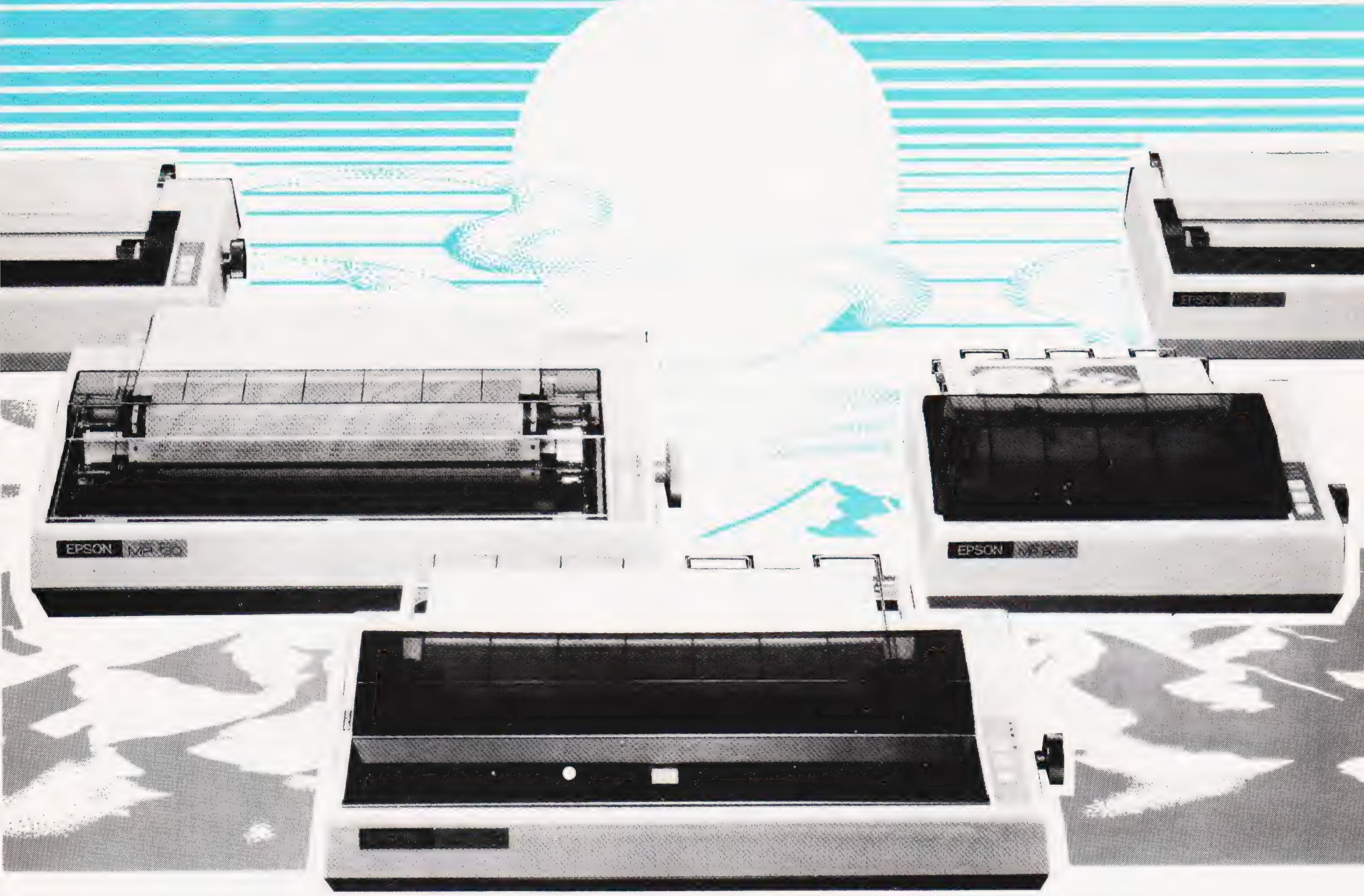

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A selection of tomes on Pascal

On last month's book page we looked at some of the innumerable titles available on BASIC. This month some books on Pascal are subjected to similar scrutiny.

Pascal 'represents an attempt at defining a programming language that is simple to learn yet well-suited for the specification of algorithms and the definition of data structures' (Zaks, 1981). It was created by Niklaus Wirth during 1970-71 and the name of the language is a tribute to the French mathematician Blaise Pascal who, it is claimed, invented the first mechanical calculating machine in 1690, at the age of 18. Pascal came on the scene, as far as micros were concerned, in about 1975. Many versions exist, but one, developed at the University of California at San Diego and therefore known as UCSD, is well adapted to the needs of micros and it was the advent of this version, in about 1978, that really caused Pascal to become popular.

The array of books on Pascal is just as overwhelming as those on BASIC. For a start, if you spend approximately £250 on UCSD Pascal, it comes complete with over 400 pages of documentation which provide a thorough, but highly technical, account of this version of the language. Then, there are a lot of hardback and softback texts written primarily for students. If what you want is a fairly straightforward account, then these are worth bearing in mind. One such is **Introduction to Pascal** by Neill Graham which provides a sound introduction to programming in general as well as to Pascal in particular.

Pascal for Programmers by Sue Eisenbach and Chris Sadler is a book that collects together a series of articles that first appeared in Personal Computer World between September 1979 and June 1980. It is intended for the 'microcomputer enthusiast who has already learned to program', so it does not cover elementary concepts and its approach is best described as mature and technical. It provides a complete introduction to the niceties of Pascal, illustrating its special features through presenting several complete programs. There is also a chapter on 'Top Down Design' which I found interesting and informative but at the same time disappointing in that it failed to convey the essence of top down programming. This book is worth considering if you already have experience of programming BASIC (or another language) and now want to learn Pascal. But, if you are a beginner, do not start here — it will leave you bewildered rather than enlightened.

One title completely out of the mainstream is **Programming For Poets: a gentle introduction using Pascal.** This book is for 'those who want to understand the computer but not necessarily use it'. This book will not really tell you much about Pascal. It is entirely non-mathematical and demonstrates computing through string handling. This gives a rather strange appraisal of a computer's capabilities, but it will make some people who may currently have no time for the new technology prepared to rethink.

The book on Pascal I would recommend, to the beginner in particular but also to many other readers, is **Introduction to Pascal** by Rodnay Zaks. It is 'designed to be read and understood by everyone, whether novice or experienced programmer, who wants to learn how to program in Pascal quickly', and different strategies for using the book are suggested according to prior knowledge. This text covers both standard and USCD Pascal and compares the two throughout. It proceeds by combining examples and exercises with thorough exposition of the concepts involved and is well paced from start to finish. It is by no means just a cookbook that allows the reader to put together programs in Pascal, but it is a work that teaches a great deal about the art of programming. Having read it one is equipped not only to write Pascal programs but to transfer what you have learnt to other high level languages. And since high level languages are likely to remain a good way of communicating with computers this makes it a book well worth adding to any collection.

Zaks' book is published by the French firm Sybex and is available in this country through Computer Bookshop who supply to bookshops and computer stores. Ask at any of these for Sybex books but in case of difficulty write to Computer Bookshop, 31 Lincoln Road, Birmingham B27 6PA.

Jacques Tiberghien's **The Pascal Handbook** is presented as a companion volume to Zaks' but it is not really in the same league, being little more than an annotated list of Pascal commands. It is intended as a work of reference and its main claim for attention is in its comprehensive coverage of the different Pascal dialects and its attempt to reconcile all of these to the newly defined ISO (International Standards Organisation) Standard. This book will be invaluable to the professional programmer who is trying to produce Pascal programs to run on a variety of machines but is not for the amateur who is writing for just one micro.

The titles included in this month's selection were:

Introduction to Pascal by Neill Graham, published by West Publishing Company (1980), 243 pages, £7.40.

Pascal for Programmers by Sue Eisenbach and Chris Sadler, published by Springer Verlag (1981), £4.90.

Programming for Poets : a gentle introduction using Pascal by R Conway, J Archer and R Conway, published by Winthrop (1980), 333 pages, £8.40.

Introduction to Pascal by Rodnay Zaks, published by Sybex (1980), 400 pages, £9.10.

The Pascal Handbook by Jacques Tiberghien, published by Sybex (1981), 473 pages, £10.05.

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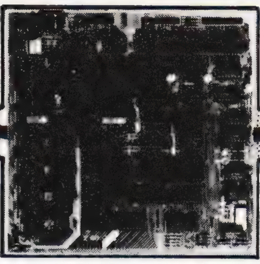

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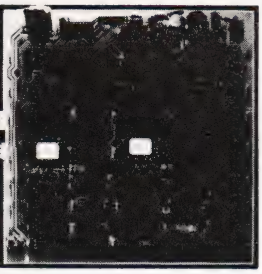

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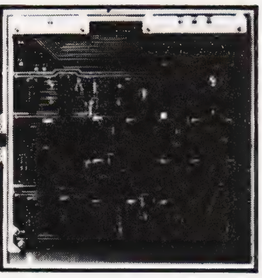

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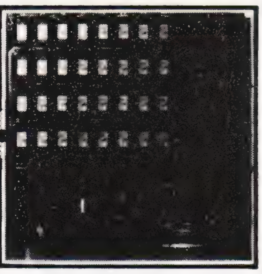

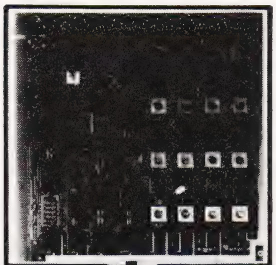

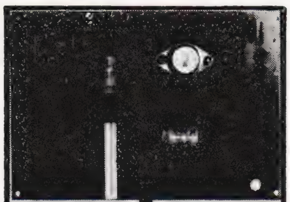

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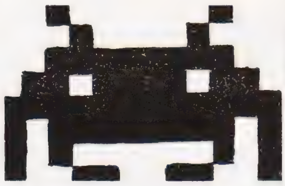

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ATOMIC PRACTICE

Peter Reber

A programmer's guide to hidden mysteries of the ATOM

The Acorn ATOM is a fairly new machine on the market. Considering its low price, many people who have little or no knowledge of computing will start with this machine and this article is intended to give them a few tips which might save them some frustration and work.

Before I start with the programs some explanations are necessary to enable non-ATOM users to follow them. The ATOM has a built-in BASIC and an assembler which work together very closely and this, I believe, may account for some of the strangeness of the BASIC.

Numbers are assumed to be in decimal. However, by preceding a number with a '#' (hash) symbol a Hex number is accepted. After PRINT a '&' (ampersand) results in a hexadecimal printout of all numbers until the next comma. The '&' is also used as a logical AND operator between two values. The '?' (query) operator serves as PEEK or POKE command depending on the context.

PRINT ? #80	Print contents of memory location 80H in decimal
?16 = #10	Load location 16 with 10H
PRINT &?7	Print contents of location 7 in hexadecimal
? #80 = ?A	Load location 80H with the value of the location A is pointing to

Furthermore, '?' used for byte indirection. This can be used to set up arrays or single byte variables.

If a single byte is sufficient to hold the variable it can result in a considerable saving of memory since normal variables in the ATOM are four bytes long. It may also be used to access a single character in a string where it is written in the form A?n:

A is any variable and it holds the 'base' address.

n is a variable or a number

The location accessed is A + n.

The percent '%' operator gives the remainder of a division. These comments should enable you to follow the given programs although more explanations will be given where appropriate.

Auto Line Listing

When writing a program, errors often seem to creep in. The ATOM then displays the appropriate error number and the line number where the interpreter thinks the error occurred. I usually LIST that section of the programs and edit the offending line. Being of a lazy nature I often wished for an automatic listing of the line with the error. This program does just that and you will be able to edit the offending line immediately.

```
  10  DIM A(40)
  20  $A = " B = ?1 + 256*?2; ? #80 = ?0;
      GOTO 1000"
  30  ?16 = A; ?17 = A& #FFFF/256
      — Program you are debugging —
1000  PRINT $6 $7 $15 [2 CR]
1010  PRINT "ERROR" ? #80 ".LINE" B
      [CR]
1020  $A = "LIST [5 SPC]"
1030  I = LEN (A)-1
1040  DO A? I = B%10 + #30; B = B/10
1050  I = I-1; UNTIL B = 0;Q
```

The standard error handler in the ATOM is a BASIC program whose start address is held in locations #10 and #11. If we write our own error handler and supply its start address to the abovementioned locations, we can deal with an error in any way we wish. The simplest way to store a short error handling program is to put it into a string. ATOM BASIC does not use tokens but stores the program exactly in the form it is written). It also enables us to change the response to an error by changing the string.

Line 20	Set up error handling instructions. Save line number in B and error number in 80H then jump to line 1000
Line 30	Set pointer to start of $A
Line 1000	$6 enables the output stream (in case it was disabled), $7 is bell, $15 turns the page mode off
Line 1010	Print error and line number
Line 1020	Set up new instructions. At least five spaces are absolutely vital for this program to operate under all conditions, because they reserve space for the line number
Lines 1040 and 1050	Convert the binary number in B to ASCII decimal characters and POKE them into $A. The $A now holds a new instruction, LIST xxx, where xxx is the line number. We now make a deliberate error, that's the reason for the lonely Q, so that the machine jumps to the error handler again and executes the new instructions.

It sometimes happens that the interpreter indicates an error in a line in which you cannot find anything wrong. The explanation is simple. When the interpreter encounters a line number when working through the program the line number is put into locations 1 and 2. If an error is found the contents of memory location 1 and 2 are printed as the line number. However, the ATOM BASIC allows multiple statement lines. If we have the following program:

```
100   GOSUB 500; X = #GG
500   RETURN
```

then you will get ERROR 91 (no Hex number after #) in line 500. The last line number found is obviously 500 because after RETURN program execution continues at X = #GG. Therefore if you have a error after a subroutine call in a multiple statement line you will get the 'wrong' line number.

Bytes FRE(E)

The amount of memory a program text uses is easily found by PRINT TOP − #2900. Location #2900 is the start of the BASIC text and TOP holds the first free memory location after the text. But, if we use arrays or strings then the requirements at RUN-time may be far higher.

You can discover how much memory you have left over at RUN-time by using the statement

```
PRINT #3C00 -(? #23 + 256 * ? #24) "BYTES
FREE"
```

It can only be used after running the program at least once. #3000 is top of text space RAM in the expanded ATOM. #23 and #24 hold what I call the free space pointer. This is used at RUN-time to hold the address of the first free memory location after a DIM statement. Let us assume that TOP has the value of #3000. When we execute a program with RUN then the free space pointer is first set to the value of TOP. Further, let us assume that in the program we will DIM a string, DIM A(10). After that, TOP still has the original value but the free space pointer now points to #300B, because 11 memory locations are now reserved for $A.

Auto RUN BASIC Programs

The ATOM has a fairly sophisticated cassette operating system. The COS commands all have a '*' (star) in ▷

front of them to distinguish them from the BASIC SAVE and LOAD command. The manual also says that it is possible to auto RUN machine code programs. The command *RUN LOADs a program, when loading is finished control is transferred to the execution address specified when the file was *SAVEd.

BASIC programs can be auto RUN as well if they are *SAVEd from start of text to TOP. The execution address should be specified, as mentioned in last December's Printout pages of Computing Today, as #CE86.

There are obviously some pitfalls, otherwise Acorn would certainly have it included in their excellent manual. The free space pointer and TOP will not be set and so you will run into trouble if the program uses arrays or strings. The first program line should therefore POKE the correct values into TOP and the free space pointer. TOP is at #0D and #0E. When you determine the values to be POKEd bear in mind that any editing is almost certain to change the value of TOP. I leave it up to you to find a way around these pitfalls.

The Assembler

The inclusion of an assembler in such a low cost machine is a distinct advantage. Although it is non-standard, like the BASIC, it does away with that terrible Hex programming and it is a delight to work with. But first, some explanations.

All variables and array elements can be used by the assembler. In fact, array elements are used as symbolic labels to hold branch and jump addresses.

The assembler is called up by BASIC when a '[' (opening square bracket) is encountered. From there onwards everything that follows is not executed but assembled until the assembler comes to ']' (closing square bracket) Note that this may cause confusion with our graphics codes at some points! Program execution will then continue in BASIC. During assembly the variable P is used as a location counter. Control is transferred to a machine code program with the LINK statement followed by a label or an address. The assembler uses the symbol '@' to denote immediate addressing. As in BASIC '#' means that it is a Hex number.

Before assembling a program I strongly recommend that all array elements used to hold branch and jump addresses during assembly are set to -1 in a FOR...NEXT loop. Otherwise something very disconcerting may happen, as it did to me. I wrote a BASIC program which included some machine code routines written with the assembler. It all worked fine and so I decided to suppress the assembly listing (PRINT $21) which speeds the process up considerably and also leaves the screen undisturbed. However, I suddenly got ERROR 156, assembler error. Yet there was nothing wrong, as far as I could see, with the line that was supposed to have the error. I removed the PRINT $21 statement — and the program assembled with no error! In short, every time I suppressed the assembly listing I got an error but when I allowed the listing it was error-free. I tried all kinds of things, to no avail. I began to suspect a ROM fault. Only when I read the description of the error message in the manual did it dawn on me what had happened. By making modification, TOP had moved and that also moved all the arrays. A array element may now hold, by chance, an address within the Zero Page. If that element is used as destination address for a direct jump or for a subroutine call you will get an error in the first pass because the assembler does not permit direct jumps or subroutine calls into the Zero Page.

As already mentioned all variables including array elements may be used by the assembler. If N has a value of #3000 then

LDA N is the same as LDA #3000
LDA N,X is the same as LDA #3000X
JMP N is the same as JMP #3000

If the value of N is not greater than #FF then

LDA (N),Y
LDA (N,X)

are also valid statements and are assembled.

However, you should avoid the use of the variable A because the assembler sometimes confuses it with accumulator addressing. INC A is not taken as 'increment the memory location A is pointing to', but as 'increment the accumulator'. There is no such instruction and the assembler indicates an error.

If you would like to access the contents of the variable itself then

LDA @N& #FF will be assembled so that the low-byte of N is loaded in the accumulator.

LDA @N& #FFFF/256 will do the same for the high-byte. The AND operation is necessary to make sure that the calculated value which will be put into the operand field by the assembler, fits into eight bits. We also have to mask byte 3 and 4 of the variable when the high-byte is calculated.

Maybe you have found already that the assembler refuses to accept a negative decimal number, eg LDX @ -1 will give an error.

It is easy to circumvent this by giving an offset of 256. For the example given LDX @ (256-1) will assemble correctly.

Subroutines

When I wrote a game recently I needed a routine to read the keyboard without stopping the game. Later, I needed a string print routine and that really sent me looking through the ROM. In the course of events I found several useful subroutines which follow. The irony is that the string print routine which actually started it is unusable because it does not end in a RTS instruction but jumps back to the interpreter which is of no use in our assembly programs. All numbers will be in Hex.

Ec : entry conditions
Ex : exit conditions (not always supplied)
R : registers used

FD1A Sounds bell. Same as CTRL G.
Ec : None R : All

FD1C Shortened version of above
Ec : A must hold a positive number of which the second digit must be 4 or 5. The higher the number the shorter the sound.
R : All

FD69 Formfeed and home cursor. Clears the screen with ASCII spaces (#20).
Ec : None R : A,Y,P

FD74 Clear screen with #40 for graphics mode 0. This is not the exact equivalent to the CLEAR 0 statement in that this entry point will set the cursor, which is turned off, to the home position. Eg if anything is printed it will appear at the top of screen and not at the bottom. The exact equivalent is not callable from a machine code program because it jumps to the interpreter.
Ec : A = #40, Y=0, B000=0, E1=0 R : A,Y,P

FD7D Home cursor
Ec : None R : A,Y,P

FE08 Scroll screen one line up
Ec : None R : A,Y,P

FE22 Erase line pointed to by #DE and #DF. If nothing is POKEd into these locations they always point to the beginning of one of the 16 VDU lines.
Ec : DE and DF hold address of first character to be erased.
R : A,Y,P

FB83 Delay. Counts flyback pulses
Ec : X holds number of pulses to count (60 decimal = 1S)
R : X,P

FB8A Delays for 1/10 S. This routine is used to set the repeating speed if the REPEAT key is pressed.
Ec : None R : X,P

FE71 Reads the keyboard. This is the routine I use for games, it does not stop the program. If no key is pressed #FF is returned in the Y register. If a key is pressed the value returned in the Y register is (ASCII-#20) CTRL and SHIFT are not recognised.
Ec : None R : All

FE66 Tests and exits on flyback pulse signal. Used for noise free write to the screen.
Ec : None R : P

F7D1 Prints the ASCII codes following the subroutine call until a negative number is found. It continues program and considers the first negative number found to be an op-code.

```
3000  JSR #F7D1   Will print OK
3001  'O          and continue
                  program
```

3002 'K at #3003
3003 NOP
3004 LDA @00
See the machine code Breakpoint handler to get an example of how a character string can be inserted into an assembly program.
Ec : None
R : A,Y,P #E8, #E9

F7FD Print one space
Ec : None R : A,P

F802 Print the contents of the accumulator as two Hex numbers.
Ec : A holds number R: A,P

FE77 Print two Hex addressess each one followed by a space. Both addresses must be held in the zero page.
Ec : Address 1 in M, M+1
Address 2 in M+2, M+3
X pointing to M
Ex : X incremented by 4
R : A,X,P

F7F3 Print Hex address followed by space.
Ec : M (zero page) holds low-byte, A holds high-byte, X points to M
Ex : X incremented by 2
R : A,X,P

F7F6 Prints contents of M(Zero Page) as two Hex numbers followed by a space
Ec : X points to M
Ex : X incremented by 2
R : A,X,P

F87E ASCII character held in accumulator is converted to a Hex number held in accumulator bits 0 to 3. Bits 4 to 7 are 0. If the number returned is the result of a valid Hex character the carry is 0 otherwise the carry is 1. ASCII characters between #3A and #40 will also return with the carry clear although they are not valid Hex characters!!
Ec : ASCII character in A
R : A,P

CD0F Print the contents of the accumulator (prompt) and then reads the keyboard with echo until RETURN is pressed or input buffer is full (64 characters). Place character into input buffer (Starts at #100). Exit on RETURN. Delete and ESC are recognised. ESC re-enters input routine but leaves the return address on the stack!
Ec : A holds prompt
Ex : A string of characters read from the keyboard, starting at #100 and terminated by #0D (Carriage return)
R : A,Y,P

F893 Converts ASCII characters in the input buffer to a Hex address. The address is returned in the zero page in location M (low-byte) and M+1 (high-byte). The routine exits on the first non-Hex character, ASCII characters between #3A and #40 excepted. If more than four characters are converted the address will consist of the four last ones. The number of characters converted minus 1 is returned in M+2.
Ec : X points to M
Y points to the first character in the input buffer which has to be converted. Absolute indexed addressing #100,Y is used.
Ex : Address in M, M+1
Number of ASCII characters converted minus one in M=2; X is unchanged.
R : A,Y,P

CA4C Increment COUNT and jump to the output routine. Use this entrypoint to print a ASCII character if you want to keep the value of COUNT correct.
Ec : ASCII character to be printed in accumulator

C589 Convert a binary number to decimal and print it within the specified field width including minus sign if negative
Ec : Binary number in #16(LSB), #25, #34, #43
Field width in #321

Memory Locations

Here is a list of memory locations which might come in useful and quite a few of these are not mentioned in the manual. All addresses are in hexadecimal.

00	Error number
01,02	BASIC line number
07	COUNT
08-0C	Random number
0D,0E	TOP
10,11	Pointer to error handler
12	Text space pointer
23,24	Free space pointer
DE,DF	Points to the start of line where next character will be printed
E0	Offset from start of VDU line Cursor position is (?DE+256*?DF+?E0) If bit 7 of E0 is set, then writing to the screen is disabled.
E1	Cursor character
E2,E3	Holds the destination address where the machine will jump to after identifying the key pressed on the keyboard.
E4	Temporary store for the X register during read or write character
E5	As E4 but for the Y register
E6	Counts line feeds in paged mode. If bit 7 of E6 is set, paged mode is off.
E7	SHIFT LOCK flag. If locked holds #60, otherwise 0.
E8,E9	Used by subroutine F7D1, print message.
321-38C	Integer variables. A is in 322 (LSB), 33D, 358, 373 (MSB), B is one location higher, C is two locations higher etc. 321 is variable @, printing field width
38D-3C0	BASIC label addresses. The address of the label is stored in the order lo-byte hi-byte starting with [A] (inverted A) at 38D. If you do not use the labels in BASIC you may use these locations but they are cleared by BREAK and the END statement.
2EB-320	Array pointers.
2EB	pointer for @@ lo-byte
306	" " @@ hi-byte
2EC	" " AA lo-byte
307	" " AA hi-byte etc.
C608-C621	Table used by subroutine C589 for binary to decimal conversion.

Breakpoint Handler

When debugging a machine code program it is useful to be able to set breakpoints where you can examine the register contents of the processor. The manual includes a breakpoint routine but it has the disadvantage that it does not permit you to return to your machine code program and it is also unwieldy, written partly in BASIC and partly in assembler. So, I set out to write my own breakpoint handler. The result is a routine, mainly in machine code, that:

a) gives a full register printout
b) prints the status register not as a Hex number, but each flag separately
c) saves and restores the screen display (with the exception of graphics mode 4), important when your program reads data from the screen memory
d) jumps to the standard error handler if the BRK occurred in the ROM (the interpreter meets detected errors with BRK). The error number will not be correct but at least you will get the line number where the error occurred
e) is self-contained and fully relocatable uses no zero page locations
f) only the BRK vector at #202, #203 has to be altered.
g) uses only #FB bytes including temporary storage for the registers.

The beginning of the assembler program may look a bit unclear, but it uses the least memory.

To compress the routine as much as possible the PC and status register are left on the stack throughout the whole routine. However, although BRK is a one byte instruction it increments the PC by two before pushing it on the stack. To be able to return from the breakpoint we have to decrement the return address by 1 so that we do not skip the byte following the BRK. For the printout I wanted the actual address of the BRK instruction, that necessitates another decrement for the address to be printed. This address is then temporarily saved on the stack. It is also tested for whether the BRK is in the ROM. If it is in the ROM we don't have to worry about the stack contents since the standard error handler automatically resets the stack pointer.

The stack pointer value is then brought into the Accumulator and 3 is added to get the address the stack pointer pointed to before the BRK instruction. The graphics mode is saved and the contents of the lower half of the VDU RAM are moved to the upper half.

Because graphics mode 4 uses all 6K of the VDU RAM this routine obviously will corrupt the display in mode 4.

The VDU is put into mode 0 and the register description is printed. The spaces are added so that we have a legible format for the printout. Location counter P is then adjusted to take account of the string. PC, A, X, Y, SP are then printed.

The status register is fetched from the stack and printed. Each bit is shifted into the carry with the as yet unprinted part of the status register being saved on the stack. The accumulator is loaded with #30, ASCII 0 and the carry is then added in. If its value was 0, the result will be #30, ASCII 0. If the carry was set, the result is #31, ASCII 1, and the correct number will be printed for each flag. To allow you to examine the registers at leisure the routine waits for any key to be pressed on the keyboard before continuing. It then restores the original graphics mode and screen contents. As the program stands there will be a delay of 1 S. If there is no wait you will probably reenter the next breakpoint so quickly that you will never know what happens on the screen. Then all registers are restored and we return from the breakpoint handler.

Program Notes

Now assemble the program. My favourite space is #2800. Unless the floating point variables are used it is safe and I don't have to worry about overwriting it unknowingly either by the program text or an array. * SAVE the object code. If you need the breakpoint handler * LOAD it, set the BRK vector #202, #203 to #2800. You can now insert as many BRK instructions as you wish into your assembler program and start debugging. The insertion of BRKs obviously moves all object code after that, one memory location up. But with the assembler that is no problem since all branch, jump and subroutine addresses will be labelled anyway. One disadvantage is that the breakpoint addresses move around and it often needs a bit of paperwork to keep track of them. The routine also does not allow the registers to be changed but until now, I never felt the need for that feature.

I hope that I have given you some useful hints which will make your programming life easier and more enjoyable.

Program Listing

```
100     DIM LL(7):REM**SPACE FOR LABELS
110     FOR I=0 TO 7
120     LL(I)=-1:REM**ZERO ALL LABELS
130     NEXT I
140     GOSUB 1000:REM**ASSEMBLE PASS 1
150     N=P:REM**SET N TO FIRST MEMORY LOCATION AFTER END
        OF ASSEMBLY PROGRAM
160     GOSUB 1000:REM**ASSEMBLE PASS 2
170     END
1000    P=#2800:REM**INITIALISE LOCATION COUNTER
1010   [:LL0                    Start of Assembly Code
1015    CLD                     Clear decimal mode
1020    STA N                   Save A at N
1030    STX N+1                 Save X at N+1
1040    STY N+2                 Save Y at N+2
1050    TSX
1060    LDA #0102,X             Get PC-low from stack
1070    SEC
1080    SBC @1                  Decrement PC-low to get
1090    BCS LL1                 correct return address; if
1100    DEC #0103,X             no borrow branch else
                                decrement PC-high
1110   :LL1 STA #0102,X         Put new PC-low onto stack
1120   LDY #0103,X              Get PC-high into Y
1130   SEC
1140   SBC @1                   Decrement PC-low for printout
1150   BCS LL2                  If no borrow branch
1160   DEY                      else decrement PC-high
1170  :LL2 PHA                  Save low-byte
1180   TYA
1190   CHP @#B0                 If BRK was in ROM
1200   BCC LL3
1210   JMP #C9D8                Jump to standard error handler
1220  :LL3 PHA                  Else save high-byte too
1230   TXA                      A now holds SP address
1240   ADC @3                   Calculate address before BRK
1250   STA N+3                  Save S at N+3
1260   LDA #B000                Save current graphics mode
1270   STA N+4
1280   LDY @0
1290  :LL4 LDA #8000,Y          Transfer the lower half
1300   STA #8600,Y              of the VDU RAM to the
1310   LDA #8100,Y              upper half
1320   STA #8700,Y
1330   LDA #8200,Y
1340   STA #8800,Y
1350   LDA #8300,Y
1360   STA #8900,Y
1370   LDA #8400,Y
1380   STA #8A00,Y
1390   LDA #8500,Y
1400   STA #8B00,Y
1410   INY
1420   BNE LL4
1430   STY #B000                Put VDU into mode 0
1440   JSR #FFED                CR/LF
1450   JSR #F7D1                Print message
1460   ]                        End of assembly marker
1470   $P="..PC..A..X..Y..S.NV-BDIZC":REM**SET UP THE
       CHARACTER STRING, NOTE THAT '.' INDICATES A SPACE
1480   P=P+LEN(P):REM**ADJUST LOCATION COUNTER FOR STRING
       PLACED IN MEMORY
1490   [                        Start of assembly code
1500   NOP                      End of text marker for SR F7D1
1510   JSR #FFED                CR/LF
1520   PLA                      Get PC-high
1530   JSR #F802                Print in Hex
1540   PLA                      Get PC-low
1550   JSR #F802                Print in Hex
1560   JSR F7FD                 Output a Space
1570   LDX @0
1580  :LL5 LDA N,X              Fetch registers from temporary
                                store
1590   JSR #F802                Print in Hex
1600   JSR #F7FD                Output a Space
1610   INX
1620   CPX @4                   Are A,X,Y and S printed?
1630   BNE LL5
1640   TSX
1650   LDA #0101,X              Fetch Status Register from
                                stack
1660   LDY @8                   Bit count
1670  :LL6 ASL A                Shift bit into Carry
1680   PHA                      Save unprinted rest of Status
                                Register
1690   LDA @#30                 ASCII '0'
1700   ADC @0                   If Carry=1 make it ASCII '1'
1710   JSR #FFF4                Print ASCII character
1720   PLA
1730   DEY
1740   BNE LL6                  Are all 8 bits printed?
1750   JSR #FFED                CR/LF
1760   JSR #FFE3                Wait for any key to be pressed
1770   LDA N+4                  Restore original graphics mode
1780   STA #B000
1790  :LL7 LDA #8600,Y          Restore original screen
1800   STA #8000,Y              display (Graphics mode 4
1810   LDA #8700,Y              excepted)
1820   STA #8100,Y
1830   LDA #8800,Y
1840   STA #8200,Y
1850   LDA #8900,Y
1860   STA #8300,Y
1870   LDA #8A00,Y
1880   STA #8400,Y
1890   LDA #8B00,Y
1900   STA #8500,Y
1910   INY
1920   BNE LL7
1930   LDX @60                  Display screen for 1 S before
1940   JSR #FB83                continuing
1950   LDY N+2                  Restore A,X and Y Registers
1960   LDX N+1
1970   LDA N
1980   RTI                      Return from Breakpoint
1990   ]                        End of assembly code
2000   RETURN
```

The breakpoint program, care is needed in its entry as it is mainly assembly code.

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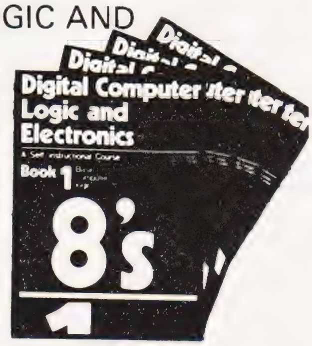

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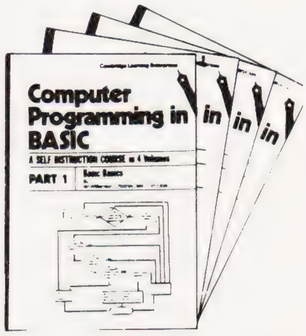

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Dear Sir,

As someone who has struggled manfully through your 6502 Machine Code series and still can't tell his ARS from his LBO I wonder if you would be good enough to prevent, or at least delay, my final steps to insanity by explaining some PEEK and POKE instructions in T G Royle's 'Snakes' from CT April '81.

In lines 120 and 710 there are PEEKs and POKEs to I/O addresses 49136 and 49139. There is most probably some very good reason for this but, for the life of me, I can't see what. And, why assign the value of PEEK(49136) to J and then make no further use of J? I removed both these PEEK and POKEs from the program and it still ran normally. Am I going mad?

Yours faithfully,
Dr John D Wafford
Boston.

(*Rest assured that your brain is not due to implode. The mysterious calls are to turn on and off the Tangerine's chunky graphics character set. The PEEK returns a dummy variable into J and turns them on, the POKE resets to a normal character set. You don't say whether you are using the Tangerine computer; one presumes that you are not because these weird manipulations are explained in the manual. Ed*)

Dear Sir,

I read with interest Richard S Marshall's letter in the August issue about the unreliability of C10/12 Micro quality cassettes. I have a Tangerine system and have found, like him, that these tapes are very unreliable, even at 300 baud. I have found that ordinary audio cassettes (not the super-cheap ones) are much more durable. My own favourites are TDK D C46s, I have never had a single error using even the Tangerine's fast rate of 2400 baud. At 55p per tape — if you shop around — they make C10/12 cassettes seem ridiculously overpriced.

Yours sincerely,
J Cameron
Redhill.

(*It is well worth noting that, quite apart from the tape quality, the type of cassette system used plays a large role in the reliability of recordings. It is often true that the cheaper the machine the better the results and this is due to the fact that many computers do not give an audio output but a square wave. The more costly recorders are carefully designed to reject such nasties, the cheaper ones just let it through. It is also worth pointing out that many of the so-called digital tapes are nothing more than audio ones in different boxes, the only true quality tapes are certified data tapes, but these do tend to cost more than many people are prepared to pay. Ed.*)

Dear Sir,

May I, tentatively, suggest a way in which I feel that your otherwise excellent magazine could be improved. Some of your programs are easily transferred between different models of microcomputer, so sometimes we need to make small changes such as 'CLS' to 'HOME' but these are soon learned. However, the use of PEEK and POKE statements are not easily transferred. I would like to suggest that you tell us the purpose of these on the particular microcomputer for which the program was written. Then it may be possible to adapt it to our own model. I realise that this is not always possible as there may be too many, or they may be used to implement a machine code routine which is CPU dependent.

I have access to an Apple and I am gradually learning its PEEKs and POKEs. For example, I have found that POKE 33,X limits the right-hand edge of the screen display. Now, if you mentioned that such-and-such a POKE did the same for the PET I could adapt programs more easily. To give a specific example I refer to the July issue where, under the heading of 'Program Portability' in the Multicolumn Records program, you mention how to change two POKEs for different brands of PET. You could have easily told us what these did. The program gives a REM for one of them but I find the other unclear from the INPUT statement. Perhaps this is due to my inexperience of a PET or computing in general.

If you implemented my suggestion the idea could possibly be extended to a series of short articles listing each month the main PEEKs and POKEs for one of the popular machines. These could be saved as a handy reference guide, in the same way as I have saved your graphics series.

Yours faithfully,
Chris Baldwin
Ware.

(*An excellent idea and one that we have considered before. The only problem is the sheer volume of data to be collected. The PET Revealed by Nick Hampshire, which does just this for one machine, runs to over 100 pages! The only realistic solution to the problem is to insist that our software writers detail the functions of these codes. Ed*)

Dear Sir,

I am concerned about the length of time that the copy typist, who prepares your program lists, has had a cold in the nose.

If you can assure me of her perfect health then perhaps you would care to explain how I can implement the "DOKE" command on my system.

Yours faithfully
D Gayler,
Maidenhead.

(*Our copy typist, heavily disguised as an Acting Editor, certainly does not have a cold! DOKE, and DEEK, are the NASCOM's way of accessing a pair of locations simultaneously. Let me explain further. If you want to load a system address into the memory of, say, a PET then you have to perform two POKEs. This is because the biggest number you can POKE is 255 and a full address needs two bytes. DOKE loads a full two-byte address in one go. Clever eh? Colds huh? Next you'll be suggesting that we take holidays! Ed.*)

Dear Sir,

In these days of frequent slow and disinterested 'service' I put pen to paper to praise Molimerx Ltd (A J Harding). After reading their catalogue I wrote off with several questions about machine code on my Video Genie. Although I was making no purchase I received a long explanatory letter from Mr Harding by return of post, and a list of the op-codes I wanted.

I have obviously written to Molimerx to thank them for this help but should be pleased if you would print this letter to prove to other readers that 'service' still has meaning in some establishments.

Yours faithfully,
A South
Bedford.

Dear Sir,

Please be kind enough to inform your readers that my address and telephone number have changed recently. I am still the Hon Sec of the Mid Sussex Microcomputer Club though.

Yours in anticipation,
Bernard Langton
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Dear Sir,

I refer to your Microlink article by Owen Bishop in the August issue. The article states that the interface requires 16 I/O data lines to control it and if the Acorn is used an INS 8154 will be necessary. However this seems strange when the ATOM is already fitted, if required, with a 6522 VIA which has two I/O ports each with eight data lines and two control lines.

Could this not be used?

Yours faithfully,
C J Garrett
Sutton.

(*Indeed it could, but you have rather missed the point. Microlinks are based around the Mk 14 and the original Acorn not the ATOM. The original Acorn is not fitted with sufficient I/O in its standard form and therefore the INS 8154 must be added. The software provided will have to be altered to operate with the 6522 device. Ed.*)

Dear Sir,

What did Mr Thorpe do to his PET to get his test program (August Issue) to run in 97 jiffies? He should also have got a different time for integer and real arrays.

His program, run on my PET, took 457 jiffies for X( ), Y( ) and 486 jiffies for X%( ), Y%( ). The longer time is caused by the conversion of the integer values to real values. This is required as calculations in PET BASIC are done using three floating point software accumulators.

If one changes line 100 to K = 1 : T = TI the time drops to 446 jiffies and 478 jiffies. Without this change both arrays need to be moved up in RAM by 7 bytes to allocate space for the K variable used in the FOR loop. As real arrays are bigger the time required to move them is longer.

This is an important point to bear in mind if one is making a program with large arrays and many simple variables.

Yours faithfully,
Colin Mair
Thurso.

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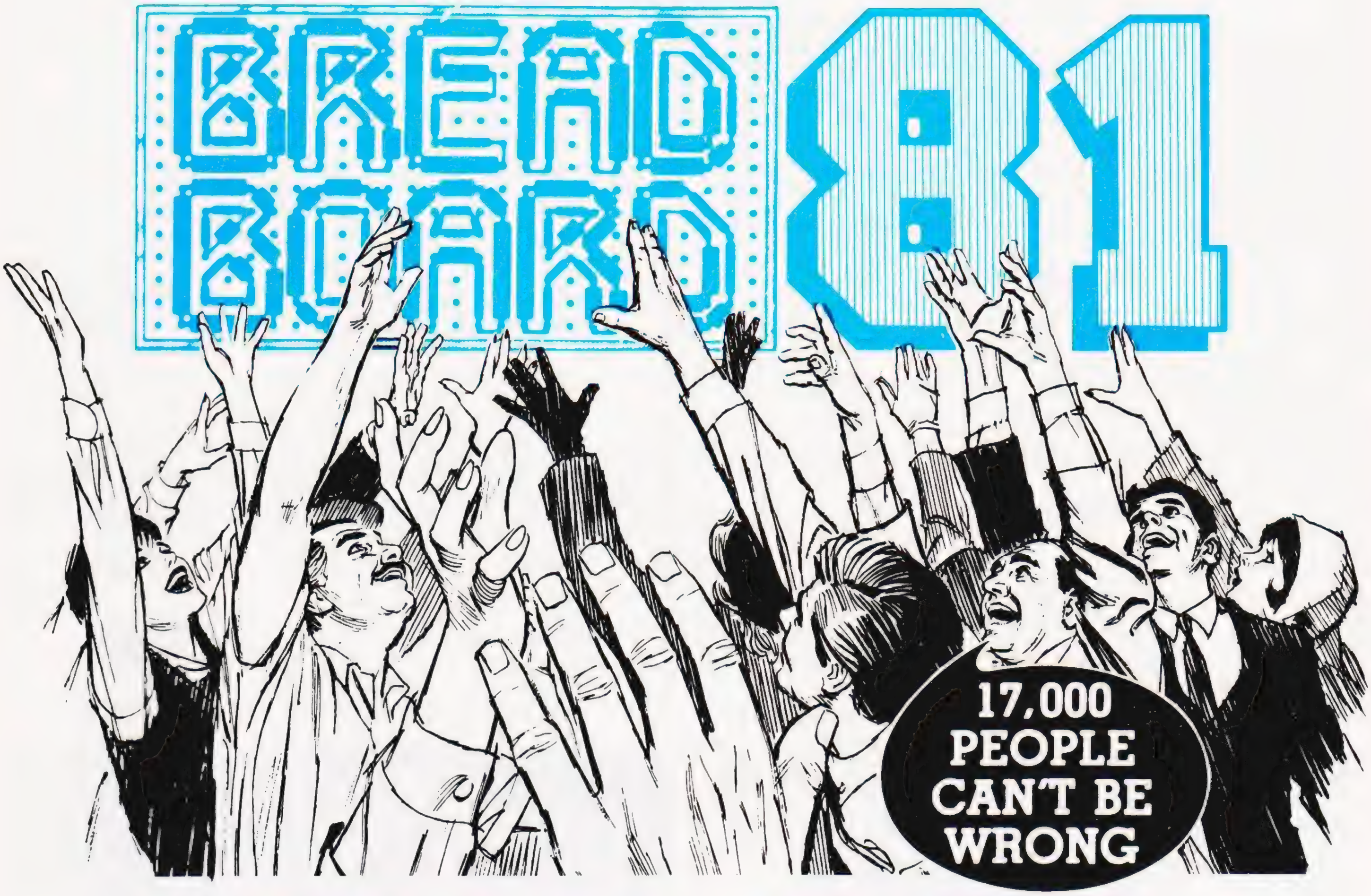

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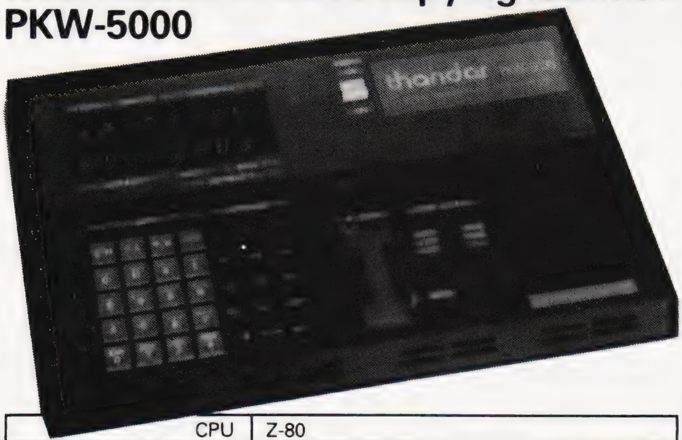

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UK101 TAPE VERIFICATION

P Beckett

Trap those loading errors

In order to ensure that a BASIC program has been successfully recorded, it is necessary to verify the tape with the program still resident in case re-recording is required.

The standard UK101 doesn't provide any facility for this but if the BASIC program listed is run, it will load the free RAM with a machine code routine that will do just this. The assembler listing shows how the program works by comparing the resident program as it is listed on the VDU with the data from the cassette on a character by character basis beginning at the first line-feed. If a discrepancy is detected it is announced on the VDU and control is handed back to BASIC to allow a re-recording to be made. If the resident program and the tape match, then the listing is completed. Whatever happens, the tape content does not affect the resident program which is always kept intact.

To Run the Program

The program, written for a standard UK101, is run by modifying the output vector to point to its start location at 0222H and then LISTing. The following line is first typed in immediate mode:

```
POKE 538,34 : POKE 539,2 : LIST
```

The tape can now be played and the verification will take place. The routine can remain resident to be activated at any time by the above method.

Program Listing

```
START=0222
START   LDA # $00       Ensure SAVE flag is cleared
        STA   $0205
        LDA # $46       Make input vector point to B.
        STA   $021A     Control will
        LDA # $02       go there when next character
        STA   $021B     is to be printed
        LDA # $71       At end of list
        STA   $04       transfer control to F
        LDA # $02
        STA   $05
A       JSR   $FE80     Loop until a LF is
        CMP# $0A        read from cassette
        BNE   A
        JSR   $FE80     Read one more character from
        JMP   $FF69     cassette and go to print routine.
B       PHA             Save character to be listed.
C       JSR   $FE80     Get a char from cassette
        STA   TEMP      but ignore nulls.
        BEQ   C
        PLA             Compare the two.
        CMP   TEMP      If no match go to D.
        BNE   D
        JMP   $FF69     Match found — print it.
D       JSR   G         Restore vectors to normal
        LDX # $00
E       LDA   MESSG,X   Print "MISMATCH.
        JSR   $FF69
        INX
        CPX # $0E
        BNE   E
        LDA # $FF       Perform CTRL O
        STA   $64       (Disable VDU).
        LDA # $0A       Load LF and finish
        JMP   $FF69     listing.
F       JSR   G         Clean up and return
        JMP   $0000     to Basic.
G       LDA # $69
        STA   $021A     Clean-up subroutine to
        LDA # $FF       put vectors back to normal.
        STA   $021B
        LDA # $C3
        STA   $04
        LDA # $A8
        STA   $05
        RTS
MESSG   0D,0A,0A,2A,2A,20,4D,49,53,4D,41,54,43,48
TEMP    0 0             Temporary storage.
```

```
63000 REM** TAPE CHECK LOADER
63010 FOR I=546 TO 663 : READ X : POKE I,X : NEXT
63020 DATA 169,0,141,5,2,169,70,141,26,2,169,2
63030 DATA 141,27,2,169,113,133,4,169,2,133,5,32
63040 DATA 128,254,201,10,208,249,32,128,254,76
63050 DATA 105,255,72,32,128,254,141,152,2,240,248
63060 DATA 104,205,152,2,208,3,76,105,255,32,119
63070 DATA 2,162,0,189,138,2,32,105,255,232,224,14
63080 DATA 208,245,169,255,133,100,169,10,76,105
63090 DATA 255,32,119,2,76,0,0,169,105,141,26,2
63100 DATA 169,255,141,27,2,169,195,133,4,169,168
63110 DATA 133,5,96,13,10,10,42,42,32,77,73,83,77
63120 DATA 65,84,67,72
```

UNCRASHING COMPUKIT

Phil Reeve

Fancy a bug-hunt?

It can be both frustrating and time-consuming to load a program repeatedly when an error is causing a crash. It is far more interesting to retrieve the lost program by tampering with the storage system. The Compukit UK101 has a pair of reset keys which make the machine code monitor always accessible.

Two situations are looked at: that of program corruption, and when pointers or addresses used by BASIC are disturbed. There are of course other reasons for failure, such as faulty program logic or bugs in BASIC, but these are not discussed here.

Storage Of BASIC

BASIC is stored in a way typical to many microcomputers, using a system of link addresses to separate each line of the program. The program will normally begin at location 0301H. Immediately following the program are the variable tables.

In addition, information defining

the program location and table positions is stored at the bottom end of RAM, in page zero (addresses 0000H to 00FFH).

The following short program is used as an example:

```
10 INPUT A
20 PRINT A-1
30 GOTO 10
```

The BASIC Program

Each line of BASIC can be looked on as having four parts. To begin, the first two locations act as a pointer, called the link address. This address is the location of the pointer preceding the next line of BASIC, and so on. The result is a chain of link addresses, each pointing to the next, with the lines of BASIC sandwiched between.

The next two locations contain the BASIC line number in Hex notation. 0A 00 is line 10.

Now follow the program statements. Commands are stored as single byte tokens, other alphanumeric characters as their ASCII equivalents and operators such as + and / with their own particular codes, not necessarily their ASCII values.

Finally, a null indicates the end of the BASIC statements. After the last line of a program, two further nulls are placed where the next link address would be. Table 1 shows the Hex codes for the example program.

The Variable Tables

Immediately after the BASIC program is an unused memory location and then the start of the variable tables. Little need be said about them for this purpose save that the top end of RAM is used for string handling, which is why it is important to restrict the memory size if this region is being used for other purposes.

The lower end of RAM is used to define the BASIC program. When a cold start is performed, these pointers are reset to indicate that there is no program present. As a program is entered these are continuously modified to describe the current situation.

Page zero is also used extensively during the running of a program, and few of these locations can be changed without affecting operation.

When an address or pointer is stored, or a number greater than 255, two bytes are needed. Values will be in Hex notation and the least significant part is always stored at the lower address. The address 0304H is stored as 04 03, the number 511 as FF 01. Table 2 sets out the locations of the relevant pointers used to define a program.

List Corruption

Various problems can arise depending on which part of the list has been affected and each has its own solution. These errors are usually simple to correct if the right cause is diagnosed. Otherwise things can go from bad to worse and it might be better to reload the program.

Corruption of link address This results in an endless stream of some character when listed. The cure is to reset warm, enter a dummy line, perhaps

```
1 A=0
```

and then delete it. The offending link address will be put right.

Corruption of line number A corrupted line number will retain its rightful position in the program and will not affect its running unless there is a call to that line. Solution — delete the line and retype.

Corruption of statement Here the usual situation is a syntax error and line that needs retyping. Due to the use of tokens the encroachment may manifest itself with a command word. Easily spotted.

The null marker The corruption will probably show as a string of glyphs or commands as the end of line cue is missed and the following characters arising from the next line's link address and line number. Again, retype the line.

Page Zero Paralysis

If the program is intact but will not run, behaves weirdly, or perhaps if BASIC cannot be reached at all, there is an approach that will effect recovery from most crashes. The much-publicised first six locations are a good first place to look and these should be 4C 74 A2 4C C3 A8. If these are all right then take the plunge and prompt a cold start. As long as there is some restriction on memory size then the program will not be lost. RAM is only cleared when the memory size defaults to the maximum. What does happen is that the pointers that define the program are reset and the first link address if over-written. So, prior to cold-starting, a note should be made of the relevant memory contents. Here is the procedure:

1) Reset to the machine code monitor, check the first few addresses and correct if necessary.
2) Inspect and note down the address given in 007B,CH, which should be the start of the first variable immediately after the program. You can check whether three nulls and an unused location precede this address. Note the link address in 0301,2H.
3) Reset, cold start with some restriction on memory size.
4) Return to the machine code monitor. Set the three pairs of addresses in 007BH to 0080H to the previously noted value. This sets the bottom end of the available RAM.
5) Set the three pairs of addresses in 0081H to 0086H to the desired memory size (00 20 for an 8K machine).
6) Enter the first link address as noted in 0301,2H. The program should now be ready to LIST and RUN.

Precautions

The greatest care should always be taken when using the POKE command. A useful safeguard when, for example, POKEing the VDU might be:

```
100 IF N<53248 OR N>54271
    THEN PRINT N:STOP
```

This can weed out a lot of problems and be removed later. A common error is the corruption of 0000H by the use of an undefined variable. One quickly learns the benefits of taking frequent copies as the work proceeds, and especially before a program is run. It may also be the only time you get up from your chair.

Address	Contents	Purpose
0079	01	First line of BASIC
007A	03	
007B	1C	Start of simple variable table
007C	03	
007D	1C	End of simple variable and start of array tables
007E	03	
007F	1C	End of array table
0080	03	
0081	00	End of string space
0082	20	
0083	00	Scratchpad address
0084	20	
0085	00	Top of memory as set by BASIC
0086	20	

Table 2 Page Zero Locations, values are for before running the example

Line Number	Hex Address	Link Address	Line Number	BASIC Statement
10	0301	08 03	0A 00	84 41 00
20	0308	11 03	14 00	97 41 A4 31 00
30	0311	19 03	1E 00	88 31 30 00
	0319	00 00		

Table 1 Program Storage

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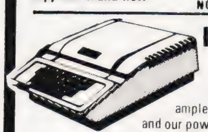

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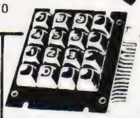

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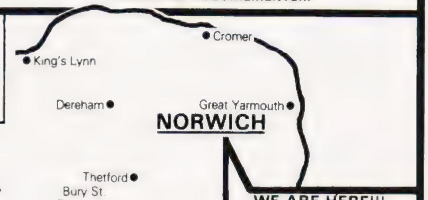

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This month we're giving the lowdown on updates to our VDU guide

In order to make more space available in the magazine for features and programs we are cutting the monthly 'Guide' down to just the updated material. This month we're just printing the updates on the VDU market but in future this will be extended to include the other categories as well. The complete guides will now be published once very four months rather than every three.

VDUs can be simply categorised into two groups, dumb and intelligent. A dumb terminal only contains the necessary electronics to take the information sent by the computer and display it on the screen, it is effectively a 'glass teletype'. An intelligent terminal, as the name suggests, contains a microprocessor and allows the user to do much more to the information on the screen *before* it is sent to the host computer.

The Featured Features

In common with our two other Guides the model type, **Manufacturer** or **Distributor** and the relevant address are given for each of the product ranges. The next piece of information is the **Screen size** which is typically 12" or 15" measured diagonally across the screen.

The **Char size** uses the same format as that in the Printer Guide. Sizes are expressed as the number of dots used to create each character.

Our next entry is **Lines x Cols** which indicates the screen format of the VDU. In general a 24 x 80 format is the most common but others do exist.

Confusion reigns with the **CA** entry! It actually stands for Cursor Addressing and if the entry beside it is 'Yes' it implies that, by a variety of methods, you can move the cursor to any given position on the screen — rather like POKE in BASIC but even more powerful. Uses of this technique are many and varied but one example is where the computer produces a form on the screen and, as you fill it in, moves the cursor to the next relevant position.

The **Colour** entry has very little to do with the aesthetics of the unit, it actually refers to the colour of the screen.

If the character set of the unit contains any **Sp. Char** these are generally simple line and form drawing graphics. Specialised graphics characters are sometimes available and the **Other fonts** entry will reveal this together with the existence of other character sets; foreign languages for example.

It is extremely useful to have separate sets of keys for the cursor and numeric functions and the information about these facilities is given in the **No of keys**, **Numeric pad** and **Cursor keys** entries.

Interfaces with the VDU are found in the **Interface** entry with the speed of operation given, if appropriate, at the **Baud rate** entry. Some VDUs are equipped with a second interface to which a printer can be attached for direct copying of the screen contents. If the VDU has one there will be an entry against **Printer port**. Similarly some VDUs allow for the connection of a **Light pen**, a device that seems to be returning to favour.

The **Price**, **Options** and **Notes** entries give the rest of the vital information that you might need.

ANN ARBOR

UPDATE

Ambassador
Dist. Digital Services Ltd.,
Fitzherbert Road, Farlington,
Portsmouth, Hants PO1 1RU
0705-324934

Screen size:- 15"
Char. size:- 7x9
Lines x Cols:- 18-60 x 80
CA:- —
Colour:- Green
Sp. Char.:- —
No. of keys:- 94
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232/20mA
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £975

Options:- More emulations, Optional phosphors.
Notes:- WP capability with 48 programmable function keys and 5 area qualifiers. All ANSI X3.64, ECMA 48 and ISO DP 6429 codings.

DATA TYPE

UPDATE

DT2/22
Manuf. Data Type Systems
Unit 23, Elliott Road,
West Howe Industrial Estate
Bournemouth BH11 8JZ
02016-6561

Screen size:- 12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- No
Sp. Char.:- With graphics option
No. of keys:- 82 (DT22 101)
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232/20mA
Baud rates:- 75-9,600
Printer port:- Yes
Light pen:- —
Other fonts:- —
Price:- —

Options:- High-Res Tektronix 4010/4012 graphics emulation, 2nd page of memory.
Notes:- DT22 has extra programmable function keys.

INSIGHT TERMINALS

UPDATE

VDT 1
Manuf. Insight Terminals
106A, Bedford Road,
Wootton, Bedford MK43 9JB
0234-768557

Screen size:- 12"
Char. size:- 7 x 12
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- P4 white
Sp. Char.:- No
No. of keys:- 103
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £499

VDT 2

Screen size:- 14"
Char. size:- 7 x 12
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- P31 Green
Sp. Char.:- No
No. of keys:- 103
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £599

TELEVIDEO

UPDATE

TVI-910
Dist. Midlectron Ltd,
Midlectron House,
Nottingham Road,
Belper, Derby DE5 13Q
077-382 6811

Screen size:- 12"
Char. size:- 8 x 10
Lines x Cols:- 24 x 80
CA:- No
Colour:- No
Sp. Char.:- No
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- —

Options:- 20mA interface, integral modem.
Notes:- ADM-3A, ADM-5, Hazeltine 1410 compatible terminal.

TOUCH TECHNOLOGY

UPDATE

Datamedia 3025A
Manuf. Touch Technology Limited
Woodgates Road, East Bergholt,
Colchester, Essex
0206 298181.

Screen size:- 12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- No
Sp. Char.:- No
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 50-9,600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £1,900

Options:- 20mA interface.
Notes:- Touch screen system for selection of options etc under program control.

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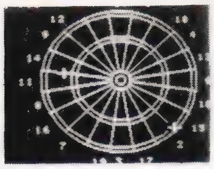
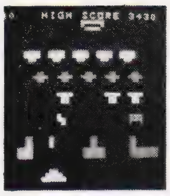


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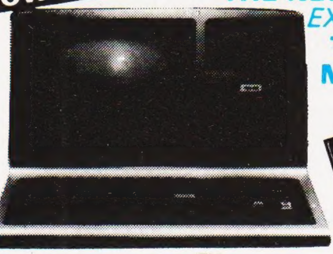

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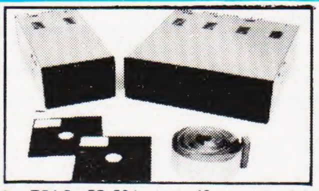

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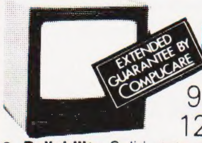

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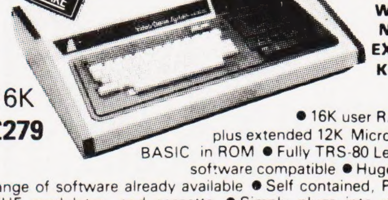

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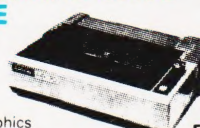

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